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Quality Assurance Project Plan
for
U.S. EPA Region V
Superfund Site Investigations in Ohio

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QUALITY ASSURANCE PROJECT PLAN
FOR
SUPERFUND SITE INVESTIGATION ACTIVITIES
CONDUCTED BY THE
OHIO ENVIRONMENTAL PROTECTION AGENCY

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ACRONYM LIST

ASTM	American Society for Testing and Materials
ABN	Acid Base Neutral Extractables
CAS	Chemical Abstracts Services
CLASS	Contract Laboratory Analytical Services Section
CLP	Contract Laboratory Program
COC	Chain of Custody
CRDL	Contract Required Detection Limits
CRL	Central Regional Laboratory
CRQL	Contract Required Quantitation Limits
DCC	Document Control Center
DERR	Division of Emergency and Remedial Response
DOT	Department of Transportation
DQO	Data Quality Objective
EAPM	Early Action Project Manager
EMSL	Environmental Monitoring and Support Laboratory
ESI	Expanded Site Investigation
FSOP	Field Standard Operating Procedure
GC/MS	Gas Chromatography Mass Spectrometry
HASP	Health and Safety Plan
HRS	Hazard Ranking System
ICP	Inductively Coupled Plasma
ICAP	Inductively Coupled Argon Plasma
IFB	Invitation for Bid
LSSS	Laboratory Scientific Support Section (CRL)
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NEIC	National Enforcement Investigations Center
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
OEPA	Ohio Environmental Protection Agency
PA	Preliminary Assessment
PCB	Polychlorinated Biphenyls
PRP	Potentially Responsible Party
QA	Quality Assurance
QAO	Quality Assurance Objectives
QAPjP	Quality Assurance Project Plan
QC	Quality Control
RAS	Regional Analytical Service
RI	Remedial Investigation
RPD	Relative Percent Difference
RSCC	Regional Sample Control Coordinator
SAS	Special Analytical Service
SI	Site Investigation
SIFU	Site Investigation Field Unit

SFD	Superfund Division
SOP	Standard Operating Procedure
SOW	Statement of Work
SSI	Screening Site Investigation
SSWP	Site Specific Work Plan
TAL	Target Analyte List
TCL	Target Compound List
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (U.S. EPA) requires all environmental agencies that perform environmentally related measurements to participate in a centrally managed quality assurance (QA) program. This program applies to all environmental monitoring, measurement, collection, and remedial activities conducted by the Ohio Environmental Protection Agency (OEPA) Division of Emergency and Remedial Response (DERR).

A requirement of this program is a written Quality Assurance Project Plan (QAPP) for all site investigations (SI) conducted by the OEPA. This QAPP provides written protocols used by the OEPA to provide legally defensible results in a court of law, and to ensure that data of known quality are used to evaluate sites. These protocols include methods to document precision, accuracy, completeness, comparability, and representativeness for all data collection activities.

This QAPP document reflects the efforts of the recipient to meet these goals for this project. The following sections within this QAPP will describe the OEPA organizational flow chart, position descriptions, sampling methodologies, quality assurance/quality control (QA/QC) protocols, deliverable requirements, data usability, laboratory requirements, and data validation procedures associated with traditional (Screening Site Inspections, Integrated Assessments, Expanded Site Assessments, Supplemental Expanded Site Assessments, and Removal Assessments) and innovative (Brownfields and Geographic Initiatives) conducted by Ohio EPA for US EPA Region 5. The OEPA will review this document annually to reflect changes in policies and procedures.

2.0 PROJECT DESCRIPTION

2.1 Project Purpose

The purpose of a SI is to collect data to rank a site using the Hazard Ranking System (HRS) and to help determine future activities for a site.

Information collected during a SI may be used to confirm Preliminary Assessments (PA) reports, previous investigations, and update site conditions.

Information will also be collected for the purposes of conducting Brownfield Assessments. Brownfield Assessments will be conducted in order to assist municipalities and other interested parties who desire to remediate potentially contaminated properties.

2.2 Project Objectives

The OEPA will conduct investigations for sites agreed upon by the U.S. EPA Region V and the OEPA. These sites will be selected based on results from site discoveries, PA reports, and other investigations which have established the need for a SI. The detail of historical documentation and the amount of hazardous materials will vary for each site.

The objectives of these investigations (phases of a SI include screening site investigations (SSI) and expanded site investigations (ESI)) are as follows:

- Characterize hazardous materials or substances, and facility waste management practices;
- Locate potential sources of contamination;
- Identify contaminant dispersal pathways and types of environmental receptors including risk to human health;
- Evaluate the need for interim remedial action, future investigations, or no further action, and;
- Provide data for HRS scoring.

2.3 Project Scope

Data gaps identified from the PA report, previous investigations, and HRS prescore will determine the scope of a SI. The scope of a SI may vary from a site reconnaissance to a very technical hydrogeologic assessment.

Most SIs will require detailed planning prior to an on-site investigation. This planning will insure that all health and safety issues are addressed in the health and safety plan (HASP), and that all data needs are included in the site specific work plan (SSWP).

2.3.1 Pre-Sampling Activities

The OEPA will perform information searches prior to conducting an on-site investigation. Information retrieved from these searches will be used to develop a SSWP and HASP. The following list describes the procedures used during a pre-sampling activity:

- * Research site files to obtain historical information about owners, operators, previous investigations (including analytical results), waste disposal practices, hazardous waste generation, and on-site operations;
- * Review aerial photographs, topographical maps, Sanborn maps, and site photographs (if available);
- * Review data from federal, state, and local regulatory agencies including the PA report, HRS prescore, regulatory violations and complaints;
- * Request site access from owner and/or operator for site reconnaissance to determine levels of protection (using field screening instruments) and to locate potential

areas of investigation;

- * Develop a SSWP, HASP, and HRS prescore;
- * Review of SSWP and HRS prescore by Site/Field Manager then U.S. EPA Region V for authorization to conduct a SI;
- * Review of HASP by OEPA Health and Safety Officer or Site/Field Manager to ensure the appropriate levels of protection will be used and that all health and safety issues have been evaluated;
- * Arrange for Contract Laboratory Program (CLP) space with the U.S. EPA Region V;
- * Arrange for site access to conduct a SI (once SSWP and HASP are approved).

Components of a SSWP are as follows:

- * Number of samples to be collected;
- * Sample matrices;
- * Site location, directions, owners, operators;
- * OEPA identification number;
- * U.S. EPA Comprehensive Environmental Response, Compensation Liability Information System (CERCLIS) identification number;
- * Data use;
- * Investigation objectives;
- * Site description;
- * Geology and hydrogeology narrative;
- * Site map;
- * Analytical methodologies;
- * Sampling methods (i.e., grab, biased,

- composite);
- * Field Standard Operation Procedures (FSOP) (e.g., instruments and protocols);
- * Sample containers requirements;
- * Team member responsibilities, and;
- * QC requirements.

Components of a HASP include: emergency information (i.e., hospital directions and phone number, ambulance phone number, hospital directions etc...), levels of protection, action levels, site information, personnel decontamination procedures, and threshold levels for suspected contaminants.

2.3.2 Sampling Activities

All SI sampling activities will begin on approval of the SSWP by the U.S. EPA and the OEPA, and completion of all pre-sampling activities.

Sampling activities (i.e., sample collection and field sample measurements) will be performed in accordance with the OEPA FSOPs provided in Appendix A. These activities include the following:

- * Calibrate instruments and prepare sampling equipment;
- * Monitor site safety conditions (with portable field instruments);
- * Locate potential sampling locations (using field screening instruments):
- * Collect environmental investigative samples, background samples, and QC samples for field screening and/or laboratory analysis;
- * Document sample collection activities, field conditions, and site

characteristics;

- * Complete sample custody documentation (e.g., sample tags, traffic reports, and shipping forms);
- * Perform continuing calibrations on field instruments, and;
- * Decontaminate field personnel and equipment.

These investigations may be performed using biased or grid sampling. The OEPA uses biased sampling to expedite locating possible sources of contamination and to identify migration pathways and environmental receptors.

The methods used to determine biased sampling locations may include: readings from portable field screening instruments, field screening by gas chromatography, chemical test kits, and field observations (e.g., stressed vegetation, stained areas, leachate seeps etc...).

Investigation-derived waste will be managed according to the guidelines stated in the U.S. EPA, "Management of Investigation-Derived Wastes During Site Inspections," (U.S. EPA/540/G-91/009), May 1991.

Modifications to FSOPs shall be approved by the Site/Field Manager, QA Officer and/or U.S. EPA Region V prior to implementation.

2.3.3 Post-Sampling Activities

A SI report is prepared on completion of all sampling activities and receipt of the analytical results. These reports will include all pertinent SI information and site prioritization using the "Hazard Ranking System; Final Rule," U.S. EPA Federal Register, 400 CFR Part 300, Vol. 55 No. 241,

December 1990.

The following list describes components of a sampling SI report. These components may vary on a site-specific basis depending on existing analytical documentation (e.g., nonsampling SI reports may be modified to exclude sections that are pertinent to sampling SIs).

- (a) **Cover letter** states site name, general statement concerning content of the attached report;
- (b) **Divisional Signatures** provide OEPA internal review and approval of the report prior submittal to the U.S. EPA Region V;
- (c) **Table of Contents** provides a serial listing of the contents, appendices, figures, and tables in a SI report;
- (d) **Executive Summary** states the date(s) of the field activities, site name, purpose of the SI, sample matrices collected during an investigation, and a general statement concerning the significant findings and pathways/receptors that may be influenced by these findings;
- (e) **Title Page** provides the date a report was finalized, the agency responsible for the report, and the site's name;
- (f) **Introduction** states the date(s) of an investigation and a reason for this investigation;
- (g) **Project Background** states information concerning prior investigations, PA reports, SI objectives, site characteristics, site location, present and past land uses on-site (i.e., waste generation and waste disposal), violations,

complaints, owners and operators, observations made during a site reconnaissance, geology and hydrogeology (including local and regional information), and reference to historical documentation (e.g., aerial maps, analytical results, Sanborn maps etc...);

- (h) **Sampling Locations and Procedures** states total number and type of sample matrices collected during an investigation, the purpose for collecting different matrices, the method used during collection, pertinent field observations, and discussion of field QC samples collected during a SI;
- (i) **State of Ohio Map and Sampling Locations Map**, the Ohio map will be used to show the location of the site within the state, the sampling location map will show the locations of samples collected on-site;
- (j) **Discussion of Analytical Results** discusses the parameters requested for analysis and data quality objectives (DQO) for the investigation. Significant findings are summarized (e.g., copper detected at 350 ug/L) in relation to their location(s) on-site ((i.e., location(s) of significant hits compared to background samples and sample location on-site) for each matrix;
- (k) **Tables of Analytical Results** list significant results for each site along with sample matrices, compounds/elements, traffic numbers, sampling time and date, sampling locations, Contract Required Detection Limits (CRDL), and Contract

Required Quantitation Limits (CRQL) are included for each method. Another table will be provided listing non-significant results using the same components stated above;

- (l) **Migration Pathways** discusses the significant findings in relation to the different pathways investigated during the investigation;
- (m) **References** list published documents and literature cited in a report;

All SI reports will be internally reviewed and approved by the OEPA prior to submittal to the U.S. EPA Region V Early Action Project Manager (EAPM).

2.4 Data Use

Data collected during a SI will be used as follows:

- * Provide information to characterize contaminants on-site, contaminants pathways, and types of receptors to be included in a SI report;
- * Provide a foundation for subsequent HRS work;
- * Supply information for emergency remedial action if the site poses an immediate health and safety threat;
- * Provide information concerning potentially responsible parties (PRP) and to supplement ESIs and Remedial Investigations (RI), and;
- * Expand information database for a site.

2.5 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clearly state the objective of a proposed site assessment; define the most

appropriate type of data to collect; determine the most appropriate conditions for data collection; and specify acceptable decision error limits that establish the quantity and quality of data needed for decision making.

Establishing DQOs for SI and Brownfields site assessments should be similar to the process that EPA uses to support decisions during remedial response activities. DQOs established for SI and Brownfields site assessments should be based on the end uses of the data to be collected and the intended future land use of the site.

The DQO process is a strategic planning approach that is designed to ensure that the type, quantity, and quality of environmental data used in decision making are appropriate for the intended application. DQOs provide a systematic procedure for defining the criteria that a data collection design should satisfy - including when to collect samples, where to collect samples, number of samples to collect, and tolerable levels of decision error.

This generic set of DQOs can be used as a basis for the site assessment, and incorporated into the sampling and analysis process.

The DQO process has both a quantitative and a qualitative statement associated with the data collection activities. The quantitative aspect seeks to use statistics to design the most efficient field investigation that limits the possibility of making an incorrect decision. The qualitative aspect seeks to encourage good planning for field investigations and compliments the statistical design.

DQO process outputs, including acceptable limits on decision errors, provide the information necessary to develop field investigations, statistical sampling designs, and sampling and analysis plans (SAPs) for a site. By using the DQO process, the scoping team establishes criteria for determining when data are sufficient for site decisions. This provides a stopping rule - a way for the management team to determine when they have collected enough data. In addition, the DQO process assists the project team to establish an adequate

level of data review/validation and documentation.

The DQO process is a valuable tool that offers several advantages. It focuses studies by clarifying vague objectives and limiting the number of decisions that must be made. The process enables data users and technical experts to specify data requirements prior to collection events. It provides a convenient way to document activities and decisions; to communicate the data collection design to others; and to give the data user confidence that the data collected support the decisions concerning remediation and redevelopment of the site. Finally, the DQO process is designed to save resources by streamlining the study process and making data collection operations more resource-effective.

The DQO process follows a prescribed seven step process which is outlined below;

- * **Step I - State the Problem** - The goal of this step is to create a well structured team of technical experts and stakeholders that will work effectively to develop a concise and complete description of the problem, which will provide the basis for the rest of the DQO development. The problem statement should include the regulatory and programmatic context of the problem, such as the regulatory objectives and basis for the field investigation. A description of the source and/or location of contamination, such as physical and chemical factors associated with the site, that could result in contaminant release or unacceptable exposures should be included. The problem definition also should include appropriate action levels for evaluating and responding to releases or exposures, and appropriate response actions.
- * **Step II - Identifying the Decsision** - The first step is to define the question that will attempt to resolve and identify the alternative actions that may be taken based on the outcome of the study. The combination of these two elements is called the decision

statement; the decision statement is critical for defining decision performance criteria later in the DQO process.

- * **Step III - Identify Inputs to the Decision -**
The scoping team must identify the different types of information that will be needed to resolve the decision statement. The outputs for the activities above include a list of informational inputs needed to make the decision and a list of environmental variables or characteristics that will be measured. The outputs of this step are actually inputs to the decision.

- * **Step IV - Defining the Boundaries of the Study**
The boundaries of the study refers to both spatial and temporal. boundaries. In order for samples to be representative of the area for which the decision will be made, the boundaries of the study must be precisely defined. Practical constraints that could interfere with sampling are also defined in this step.

The temporal boundaries of the decision should also be defined. It may not be possible to collect data over the full time period to which the decision will apply. Scoping team members will address these concerns in relation a number of affecting issues. Examples of such affecting issues could include; length of time established for the collection of data, and seasonal time of year the samples are to be collected.

Practical constraints on data collection also need to be recognized. These constraints include meteorological conditions when sampling is not possible; inability to gain site access or informed consent; or the unavailability of personnel, time, or equipment.

- * **Step 5 - Developing a Decision Rule -** The purpose of developing a decision rule is to integrate the output from the previous steps of the DQO process into a statement that defines the

parameter of interest; delineates the scale of decision making; specifies the action level; and describes the logical basis for choosing among alternative actions.

The out put for this step is to develop an "if,...then" statement that defines the conditions that would cause the decision maker to choose among alternative courses of action. This is typically the statistical parameter of interest, which is a descriptive measure, (such as a mean, median, proportion, or maximum) that specifies the characteristic that the decision maker would like to know about a given population.

*** Step 6 - Specifying Limits on Decision Errors**

Due to the inexact nature of sampling, and the potential for decisions to be made based on innacurate measurement data, acceptable limits on the probability of making a decision error should be developed. These limits are incorporated into the sampling and analysis plan for the SI and Brownfields site assessment. Often, data may be suspect or questionable. Measurement errors can happen during sample collection, handling, preparation, analysis, data reduction, or data handling. There may be corrective steps that can be taken or additional qualifying information that can be collected that will allow the full or limited use of the data. These are corrective actions, and some forethought will be given to detemining corrective action scenarios during this step.

*** Step 7 - Optimizing the Design** - The purpose of this step is to identify the most resource-effective sampling design that generates data which satisfy the DQOs specified in the preceding steps. In most cases, this decision involves the type and number of samples deemed necessary to characterize a site or an area of the site. The most frequently encountered sampling approaches are; probabilistic, non-probabilistic, and/or judgemental. The later two sampling approaches are ones most typically associated with Brownfields projects.

The scoping team should review the outcomes of the previous DQO process steps to determine exactly how the limits on decision errors will prescribe the number and location of samples to be collected and the types of analyses per sample. The result of this activity will be the design options for the project. Once the final design has been selected, dosumnetation of the chosen design will be created. This will assist in improving the efficiency and effectiveness of development of field sampling procedures, quality control procedures, and statistical procedures for data analysis.

Data validation for all samples collected during a SI will occur at the discretion of the U.S. EPA Region V Superfund Division. Only those results deemed acceptable and qualified by U.S. EPA Region V may be used to evaluate a site in the SI report.

The U.S. EPA provides the following guidelines for using analytical results in the HRS scoring procedure:

- (1) If the background results are less than the CRDL/CRQL, then the associated investigative sample results are deemed significant for scoring if they are found at concentrations equal to or above the CRDL/CRQL, or;
- (2) If the background results are greater than the CRDL/CRQL, then the associated investigative sample results are deemed significant for scoring if they are found at concentrations three times the concentration (for that analyte) found in the background sample.

Background samples will be collected for each potentially affected matrix. At least one background sample must be collected for each pathway being investigated. The purpose of these samples is to determine if the site's contamination exceeds background levels characteristic to the area and if the contamination on-site can be attributed to the site being investigated.

Results from these samples will be used in HRS scoring; therefore, stringent QC/QA procedures must be used during

collection. Background surface water samples will be collected upstream of the site, while leachates from the site to surface water will not require background samples.

2.6 Project Schedule

The time schedule for a SI will be dependent on specific project requirements. Those investigations requiring an extensive study will require additional time allotments.

Each SSWP will specify the time schedule for that SI. The U.S. EPA SAM will be notified and approve of any SI activity that will exceed the guidelines established in the PA/SI Cooperative Agreement.

2.7 Analytical Requirements

Samples collected during a SI may be analyzed for the compounds and elements listed in the following tables. These tables list the quantitation/detection limits associated with specific CLP or CRL Statement of Work (SOW). The SSWP will indicate the methods and matrices for a site.

Some sites may require additional methods provided only by SAS. Note that the CLP no longer solicits SAS work. Central Regional Lab can perform specific tasks/methods if appropriate SOPs and coordination is provided. These methods will be determined based on findings of the pre-sampling activities. The OEPA Field Investigator will prepare SAS request forms for the U.S. EPA RSCC or the State to approve and implement. These forms may contain any of the following analytical procedures:

- * Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, U.S. EPA SW-846, 3rd Edition, 1986 with revisions (or most recent version/update).
- * Methods for Chemical Analysis of Water and Wastes, U.S. EPA 600/4-79-020, March 1983 (or

most current version will be used).

- * Standard Methods for the Examination of Water and Wastewater, American Public Health, 16th Edition, 1985 (or most recent version will be used).
- * Procedures for Handling and Chemical Analysis of Sediment and Wastewater Samples, U.S. EPA and Corps of Engineers, May 1985 (or most recent version).
- * National Institute of Occupational Safety and Health (NIOSH) Manual of Analytical Methods, 3rd Edition, February 1984 (or most recent version).
- * Quality Assurance Handbook for Air Pollution Measurements Systems, U.S. EPA-600/9-76-005 with revisions (or most recent version).
- * U.S. EPA Region V Standardized SAS Requests, 1987 (or most recent version).

TABLE A

TARGET COMPOUND LIST
 CONTRACT REQUIRED QUANTITATION LIMITS

<u>Volatiles</u>	<u>CAS Number</u>	<u>Water</u> (ug/L)	Quantitation Limits ¹		
			<u>Low</u> <u>Soil</u> (ug/Kg)	<u>Med.</u> <u>Soil</u> (ug/Kg)	<u>High</u> ² <u>Conc.</u> (mg/Kg)
Chloromethane	74-87-3	10	10	1200	5
Bromomethane	74-83-9	10	10	1200	5
Vinyl chloride	75-01-4	10	10	1200	5
Chloroethane	75-00-3	10	10	1200	5
Methylene chloride	75-09-2	10	10	1200	2.5
Acetone	67-64-1	10	10	1200	5
Carbon disulfide	75-15-0	10	10	1200	2.5
1,1-Dichloroethene	75-35-4	10	10	1200	2.5
1,1-Dichloroethane	75-34-3	10	10	1200	2.5
1-2-Dichloroethene-					
(total)	540-59-0	10	10	1200	2.5
Chloroform	67-66-3	10	10	1200	2.5
1,2-Dichloroethane	107-06-2	10	10	1200	2.5
2-Butanone	78-93-3	10	10	1200	5
1,1,1-Trichloroethane	71-55-6	10	10	1200	2.5
Carbon tetrachloride	56-23-5	10	10	1200	2.5
Bromodichloromethane	75-27-4	10	10	1200	2.5
1,2-Dichloropropane	78-87-5	10	10	1200	2.5
cis-1,3-Dichloro-					
propane	10061-01-5	10	10	1200	2.5
Trichloroethene	79-01-6	10	10	1200	2.5
Dibromochloromethane	124-48-1	10	10	1200	2.5
1,1,2-Trichloroethane	79-00-5	10	10	1200	2.5
Benzene	71-43-2	10	10	1200	2.5
trans-1,3-Dichloro-					
propane	10061-02-6	10	10	1200	2.5

¹ Quantitation limits listed for soil and sediment are based on wet weight. The quantitation limits calculated on a dry weight basis will be higher.

² Results for both solid and liquid samples are reported as mg/Kg, wet weight.

TABLE A
 (cont.)

TARGET COMPOUND LIST
 CONTRACT REQUIRED QUANTITATION LIMITS

<u>Volatiles</u>	<u>CAS Number</u>	<u>Water</u> (ug/L)	Quantitation Limits		
			<u>Low</u> <u>Soil</u> (ug/Kg)	<u>Med.</u> <u>Soil</u> (ug/Kg)	<u>High</u> <u>Conc.</u> (mg/Kg)
Bromoform	75-25-2	10	10	1200	2.5
4-Methyl-2-pentanone	108-10-1	10	10	1200	5
2-Hexanone	591-78-6	10	10	1200	5
Tetrachloroethene	127-18-4	10	10	1200	2.5
Toluene	108-88-3	10	10	1200	2.5
1,1,2,2-Tetrachloroethane	79-34-5	10	10	1200	2.5
Chlorobenzene	108-90-7	10	10	1200	2.5
Ethylbenzene	100-41-4	10	10	1200	2.5
Styrene	100-42-5	10	10	1200	2.5
Xylenes (total)	1330-20-7	10	10	1200	2.5

TABLE B

TARGET COMPOUND LIST
CONTRACT REQUIRED QUANTITATION LIMITS

<u>Semi-volatiles</u>	<u>CAS Number</u>	<u>Water</u> (ug/L)	Quantitation Limits ¹		
			<u>Low</u> <u>Soil</u> (ug/Kg)	<u>Med.</u> <u>Soil</u> (ug/Kg)	<u>High</u> ² <u>Conc.</u> (mg/Kg)
Phenol	108-95-2	10	330	10000	20
bis(2-Chloroethyl) - ether	111-44-4	10	330	10000	20
2-Chlorophenol	95-57-8	10	330	10000	20
1,3-Dichlorobenzene	541-73-1	10	330	10000	20
1,4-Dichlorobenzene	106-46-7	10	330	10000	20
1,2-Dichlorobenzene	95-50-1	10	330	10000	20
2-Methylphenol	95-48-7	10	330	10000	20
2,2'-oxybis- (1-Chloropropane)	108-60-1	10	330	10000	20
4-Methylphenol	106-44-5	10	330	10000	20
N-Nitroso-di-n- propylamine	621-64-7	10	330	10000	20
Hexachloroethane	67-72-1	10	330	10000	20
Nitrobenzene	98-95-3	10	330	10000	20
Isophorone	78-59-1	10	330	10000	20
2-Nitrophenol	88-75-5	10	330	10000	20
2,4-Dimethylphenol	105-67-9	10	330	10000	20
bis(2-Chloroethoxy) - methane	111-91-1	10	330	10000	20
2,4-Dichlorophenol	120-83-2	10	330	10000	20
1,2,4-Trichlorobenzene	120-82-1	10	330	10000	20
Naphthalene	91-20-3	10	330	10000	20
4-Chloroaniline	106-47-8	10	330	10000	20
Hexachlorobutadiene	87-68-3	10	330	10000	20

¹ Quantitation limits for soil and sediment are based on wet weight. The quantitation limits calculated on a dry weight basis will be higher.

² Results for both solid and liquid samples are reported in mg/Kg, wet weight.

TABLE B
(cont.)

TARGET COMPOUND LIST
CONTRACT REQUIRED QUANTITATION LIMITS

<u>Semi-volatiles</u>	<u>CAS Number</u>	Quantitation Limits			
		<u>Water</u> (ug/L)	<u>Low Soil</u> (ug/Kg)	<u>Med. Soil</u> (ug/Kg)	<u>High Conc.</u> (mg/Kg)
4-Chloro-3-methylphenol	59-50-7	10	330	10000	20
2-Methylnaphthalene	91-57-6	10	330	10000	20
Hexachlorocyclopentadiene	77-47-4	10	330	10000	20
2,4,6-Trichlorophenol	88-06-2	10	330	10000	20
2,4,5-Trichlorophenol	95-95-4	25	800	25000	100
2-Chloronaphthalene	91-58-7	10	330	10000	20
2-Nitroaniline	88-74-4	25	800	25000	100
Dimethyl phthalate	131-11-3	10	330	10000	20
Acenaphthylene	208-96-8	10	330	10000	20
2,6-Dinitrotoluene	606-20-2	10	330	10000	20
3-Nitroaniline	99-09-2	25	800	25000	100
Acenaphthene	83-32-9	10	330	10000	20
2,4-Dinitrophenol	51-28-5	25	800	25000	100
4-Nitrophenol	100-02-7	25	800	25000	100
Dibenzofuran	132-64-9	10	330	10000	20
2,4-Dinitrotoluene	121-14-2	10	330	10000	20
Diethyl phthalate	84-66-2	10	330	10000	20
4-Chlorophenyl-phenyl	7005-72-3	10	330	10000	20
Fluorene	86-73-7	10	330	10000	20
4-Nitroaniline	100-01-6	25	800	25000	100
4,6-Dinitro-2-methyl-phenol	534-52-1	25	800	25000	100
N-Nitrosodiphenyl amine	86-30-6	10	330	10000	20
4-Bromophenyl-phenyl-ether	86-30-6	10	330	10000	20
Hexachlorobenzene	118-74-1	10	330	10000	20
Pentachlorophenol	87-86-5	25	800	25000	100
Phenanthrene	85-01-8	10	330	10000	20
Anthracene	120-12-7	10	330	10000	20

TABLE B
(cont.)

TARGET COMPOUND LIST
CONTRACT REQUIRED QUANTITATION LIMITS

<u>Semi-volatiles</u>	<u>CAS Number</u>	<u>Quantitation Limits</u>			
		<u>Water</u> (ug/L)	<u>Low Soil</u> (ug/Kg)	<u>Med. Soil</u> (ug/Kg)	<u>High Conc.</u> (mg/Kg)
Carbazole	86-74-8	10	330	10000	NA ³
Di-n-butyl phthalate	86-74-2	10	330	10000	20
Fluoranthene	206-44-0	10	330	10000	20
Pyrene	129-00-0	10	330	10000	20
Butylbenzyl phthalate	85-68-7	10	330	10000	20
3,3-Dichlorobenzidine	91-94-1	10	330	10000	40
Benzo(a) anthracene	56-55-3	10	330	10000	20
Chrysene	210-01-9	10	330	10000	20
bis(2-ethylhexyl) phthalate	117-81-7	10	330	10000	20
Di-n-octyl phthalate	117-84-0	10	330	10000	20
Benzo(b) fluoranthene	205-99-2	10	330	10000	20
Benzo(k) fluoranthene	207-08-9	10	330	10000	20
Benzo(a) pyrene	50-32-8	10	330	10000	20
Indeno(1,2,3-cd) pyrene	193-39-5	10	330	10000	20
Dibenzo(a,h) anthracene	53-70-3	10	330	10000	20
Benzo(g,h,i) perylene	191-24-2	10	330	10000	20

Additional High Concentration Compounds

Benzoic acid	65-85-0	100
Benzyl alcohol	100-51-6	20
Monochlorobiphenyl	27323-18-8	100
Dichlorobiphenyl	2051-60-7	100
Trichlorobiphenyl	2051-61-8	100
Tetrachlorobiphenyl	2051-62-9	100
Hexachlorobiphenyl	26601-64-9	100
Pentachlorobiphenyl	25429-29-2	100
Heptachlorobiphenyl	28655-71-2	100
Octachlorobiphenyl	55722-26-4	200

³ NA is not applicable.

Nonachlorobiphenyl	53742-07-7	200
Decachlorobiphenyl	2051-24-3	200

TABLE C

TARGET COMPOUND LIST
 CONTRACT REQUIRED QUANTITATION LIMITS

<u>Pesticides/Aroclors</u>	<u>CAS Number</u>	Quantitation Limits ¹		
		<u>Water</u> (ug/L)	<u>Low Soil</u> (ug/Kg)	<u>High² Conc.</u> (mg/Kg)
alpha-BHC	319-84-6	0.05	1.7	20
beta-BHC	319-85-7	0.05	1.7	20
delta-BHC	319-86-8	0.05	1.7	20
gamma-BHC (Lindane)	58-89-9	0.05	1.7	20
Heptachlor	76-44-8	0.05	1.7	20
Aldrin	309-00-2	0.05	1.7	20
Heptachlor epoxide	1024-57-3	0.05	1.7	20
Endosulfan I	959-98-8	0.05	1.7	20
Dieldrin	60-57-1	0.10	3.3	20
4,4'-DDE	72-55-9	0.10	3.3	20
Endrin	72-20-8	0.10	3.3	20
Endosulfan II	33213-65-9	0.10	3.3	20
4,4'-DDD	72-54-8	0.10	3.3	20
Endosulfan sulfate	1031-07-8	0.10	3.3	20
4,4'-DDT	50-29-3	0.10	3.3	20
Methoxychlor	72-43-5	0.50	17.0	20
Endrin ketone	53494-70-5	0.10	3.3	20
Endrin aldehyde	7421-36-3	0.10	3.3	NA
alpha chlordanes	5103-71-9	0.05	1.7	20
gamma chlordanes	5103-74-2	0.05	1.7	20

¹ The quantitation limits listed for soil and sediment are based on wet weight. The quantitation limits calculated for soil or sediment on a dry weight basis will be higher.

Low and medium samples are not differentiated in this method.

² Solid and aqueous high concentrations samples will be reported in mg/Kg wet weight.

TABLE C
(cont.)

TARGET COMPOUND LIST
CONTRACT REQUIRED QUANTITATION LIMITS

Quantitation Limits				
<u>Pesticides/Aroclors</u>	<u>CAS Number</u>	<u>Water</u> (ug/L)	<u>Low</u> <u>Soil</u> (ug/Kg)	<u>High</u> <u>Conc.</u> (mg/Kg)
Toxaphene*	8001-35-2	5.0	170.0	50
Aroclor 1016*	12674-11-2	1.0	33.0	10
Aroclor 1221*	11104-28-2	1.0	33.0	10
Aroclor 1232*	11141-16-5	2.0	67.0	10
Aroclor 1242*	53469-21-9	1.0	33.0	10
Aroclor 1248*	12672-29-6	1.0	33.0	10
Aroclor 1254*	11097-69-1	1.0	33.0	10
Aroclor 1260*	11096-82-5	1.0	33.0	10

TABLE D

TARGET ANALYTE LIST
 CONTRACT REQUIRED DETECTION LIMITS

<u>Analyte</u>	<u>CAS Number</u>	<u>Detection Limits^{ab}</u>		
		<u>Water</u> (ug/L)	<u>Soil¹</u> (mg/Kg)	<u>High Conc.²</u> (mg/Kg)
Aluminum	7429-90-5	200	40	80
Antimony	7440-36-0	60	12	20
Arsenic	7440-38-2	10	2	5
Barium	7440-39-3	200	40	80
Beryllium	7440-41-7	5	1	5
Cadmium	7440-43-9	5	1	10
Calcium	7440-70-2	5000	1000	80
Chromium	7440-47-3	10	2	10
Cobalt	7440-48-4	50	10	20
Copper	7440-50-8	25	5	40
Iron	7439-89-6	100	20	20
Lead	7439-92-1	3	0.6	10
Magnesium	7439-95-4	5000	1000	80
Manganese	7439-96-5	15	3	10
Mercury	7439-97-6	0.2	0.1	0.3
Nickel	7440-02-0	40	8	20
Potassium	7440-09-7	5000	1000	-
Selenium	7782-49-2	5	1	5
Silver	7440-22-4	10	2	10
Sodium	7440-23-5	5000	1000	80
Thallium	7440-28-0	10	2	20
Vanadium	7440-62-2	50	10	20
Zinc	7440-66-6	20	4	10
Cyanide	57-12-5	10	2	1.5

¹ The CRDLs (equivalent to CRQLs) listed above for soil are based on wet weight. These CRDLs will be adjusted for percent moisture elevating those listed above.

² These CRDLs are for high concentrations samples only. Solid and aqueous samples will be reported in mg/Kg wet weight.

TABLE D
(cont.)

TARGET ANALYTE LIST
CONTRACT REQUIRED DETECTION LIMITS

<u>Analyte</u> <u>Conc.</u>	<u>CAS Number</u>	<u>Detection Limits</u>		
		<u>Water</u>	<u>Soil</u>	<u>High</u>

(ug/L)
(mg/Kg)

Additional High Concentration Analyses

Conductivity	3.0
--------------	-----

umhos/cm

pH

NA

a. Subject to the restrictions specified in the first page of Part G, Section IV of Exhibit D (Alternate Methods - Catastrophic Failure) any analytical method specified in SOW Exhibit D may be utilized as long as the documented instrument or method detection limits meet the Contract Required Detection Limit (CRDL) requirements. Higher detection limits may only be used in the following circumstance:

If the sample concentration exceeds five times the detection limit of the instrument or method in use, the value may be reported even though the instrument or method detection limit may not equal the CRDL. This is illustrated in the example below:

Lead:

Method: ICP
Instrument Detection Limit (IDL) = 40
Sample Concentration = 220
CRDL = 3

The value of 220 may be reported even though the IDL is greater than CRDL. The instrument or method detection limit must be documented as described in Exhibit E.

- b. The CRDL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

TABLE E

RESIDENTIAL WELL COMPOUND LIST AND QUANTITATION LIMITS

<u>Volatiles</u>	<u>CAS Number</u>	<u>Quantitation Limits</u>	
		<u>CRL</u> (ug/L)	<u>CLP</u> (ug/L)
Benzene	71-43-2	1.0	1.0
Bromdichloromethane	75-27-4	1.0	1.0
Bromoform	75-25-2	1.0	1.0
Bromomethane	74-83-9	3.0	1.0
Carbon tetrachloride	56-23-5	1.0	1.0
Chlorobenzene	108-90-7	1.0	1.0
Chloroethane	75-00-3	3.0	1.0
Chloroform	67-66-3	1.0	1.0
Chloromethane	74-87-3	3.0	1.0
Dibromochloromethane	124-48-1	1.0	1.0
1,1-Dichloroethane	75-34-3	1.0	1.0
1,2-Dichloroethane	107-06-2	1.0	1.0
1,1-Dichloroethene	75-35-4	1.0	1.0
1,2-Dichloroethene (total)	540-59-0	1.0	1.0
1,2-Dichloropropane	78-87-5	1.0	1.0
cis-1,3-Dichloropropene	10061-01-5	1.0	1.0
trans-1,3-Dichloropropene	10061-02-6	1.0	1.0
Ethylbenzene	100-41-4	1.0	1.0
Methylene chloride (1)	75-09-2	1.0	2.0
1,1,2,2-Tetrachloroethane	79-34-5	1.0	1.0
Tetrachloroethene	127-18-4	1.0	1.0
Toluene (1)	108-88-3	1.0	1.0
1,1,1-Trichloroethane	71-55-6	1.0	1.0
1,1,2-Trichloroethane	79-00-5	1.0	1.0
Trichloroethene	79-01-6	1.0	1.0
Vinyl chloride	75-01-4	3.0	1.0
Acrolein	107-02-8	75.0	NA ¹
Acetone (1)	67-64-1	50.0	5.0
Acrylonitrile	107-13-1	50.0	NA
Carbon disulfide	75-15-0	2.0	1.0
2-Butanone (1)	78-93-3	20.0	5.0
Vinyl acetate	108-05-4	10.0	1.0

¹ NA = not applicable.

4-Methyl-2-pentanone	108-10-1	4.0	5.0
2-Hexanone	519-78-6	4.0	5.0

TABLE E
 (cont.)

RESIDENTIAL WELL COMPOUND LIST AND QUANTITATION LIMITS

<u>Volatiles</u>	<u>CAS Number</u>	<u>Quantitation Limits</u>	
		<u>CRL</u> (ug/L)	<u>CLP</u> (ug/L)
Styrene	100-42-5	2.0	1.0
m-Xylene	108-38-3	2.0	NA
o-Xylene (2)	95-47-6	2.1	NA
p-Xylene (2)	106-42-3	2.1	NA
Xylenes (total)	1330-20-7	NA	1.0
1,3-Dichlorobenzene	541-73-1	NA	1.0
1,4-Dichlorobenzene	106-46-7	NA	1.0
1,2-Dichlorobenzene	95-50-1	NA	1.0
1,2-Dibromo-3-chloropropane	92-12-8	NA	1.0

NOTES: (1) Common laboratory solvent; (2) o & p xylenes are reported as a total of the two isomers.

TABLE F

RESIDENTIAL WELL COMPOUND LIST AND QUANTITATION LIMITS

<u>Semi-volatiles</u>	<u>CAS Number</u>	<u>Quantitation Limits</u>	
		<u>CRL</u> (ug/L)	<u>CLP</u> (ug/L)
bis(2-chloroethyl) Ether	111-44-4	1.5	5
Phenol	108-95-2	2.0	5
2-Chlorophenol	95-57-8	2.0	5
1,3-Dichlorobenzene	541-73-1	2.0	5
1,4-Dichlorobenzene	106-46-7	2.0	5
1,2-Dichlorobenzene	95-50-1	2.5	5
Benzyl alcohol	100-51-6	2.0	NA
bis(2-chloroisopropyl) Ether	39638-32-9	2.5	NA
2-Methylphenol	95-48-7	1.0	5
Hexachloroethane	67-72-1	2.0	5
N-Nitroso-di-n-propylamine	621-64-7	1.5	5
Nitrobenzene	98-95-3	2.5	5
4-Methylphenol	106-44-5	1.0	5
Isophorone	78-59-1	2.5	5
2-Nitrophenol	88-75-5	2.0	5
2,4-Dimethylphenol	105-67-9	2.0	5
bis(2-chloroethoxy) Methane	111-91-1	2.5	5
2,4-Dichlorophenol	120-83-2	2.0	5
1,2,4-Trichlorobenzene	120-82-1	2.0	5
Naphthalene	91-20-3	2.0	5
4-Chloroaniline	106-47-8	2.0	5
Hexachlorobutadiene	87-68-3	2.5	5
Benzoic acid	65-85-0	30.0	NA
2-Methyl naphthalene	91-57-6	2.0	5
4-Chloro-3-methylphenol	59-50-7	1.5	5
Hexachlorocyclopentadiene	77-47-4	2.0	5
2,4,6-Trichlorophenol	88-06-2	1.5	5
2,4,5-Trichlorophenol	95-95-4	1.5	5
2-Chloronaphthalene	91-58-7	1.5	5
Acenaphthylene	208-96-8	1.5	5
Dimethyl phthalate	131-11-3	1.5	5
2,6-Dinitrotoluene	606-20-2	1.0	5
Acenaphthene	83-32-9	1.5	5
3-Nitroaniline	99-09-2	2.5	20
Dibenzofuran	132-64-9	1.0	5
2,2'-oxybis-(1-Chloropropane)	108-60-1	NA	5

TABLE F
 (cont.)

RESIDENTIAL WELL COMPOUND LIST AND QUANTITATION LIMITS

<u>Semi-volatiles</u>	<u>CAS Number</u>	<u>Quantitation Limits</u>	
		<u>CRL</u> (ug/L)	<u>CLP</u> (ug/L)
2,4-Dinitrophenol	51-28-5	(15.0) ¹	20
2,4-Dinitrotoluene	121-14-2	1.0	5
Fluorene	86-73-7	1.0	5
4-Nitrophenol	100-02-7	1.5	20
4-Chlorophenylphenyl ether	7005-72-3	1.0	5
Diethyl phthalate	84-66-2	1.0	5
4,6-Dinitro-2-methylphenol	534-52-1	(15.0)	20
N-Nitrosodiphenylamine	86-30-6	1.5	5
Diphenylamine ²	122-39-4	NA	NA
4-Nitroaniline	100-01-6	3.0	20
4-Bromophenylphenyl ether	101-55-3	1.5	5
Hexachlorobenzene	118-74-1	1.5	5
Pentachlorophenol	87-86-5	2.0	20
Phenanthrene	85-01-8	1.0	5
Anthracene	120-12-7	2.5	5
Di-n-butyl phthalate	84-74-2	2.0	5
Fluoranthene	206-44-0	1.5	5
Pyrene	129-00-0	1.5	5
Butylbenzyl phthalate	85-68-7	3.5	5
Chrysene	218-01-9	1.5	5
Benzo(a) anthracene	56-55-3	1.5	5
Bis(2-Ethylhexyl) phthalate	117-81-7	1.0	5
Di-n-octyl phthalate	117-84-0	1.5	5
Benzo(b) fluoranthene	205-99-2	1.5	5
Benzo(k) fluoranthene	207-08-9	1.5	5
Benzo(a) pyrene	50-32-8	2.0	5
Indeno(1,2,3-cd) pyrene	193-39-5	3.5	5
Dibenzo(a,h) anthracene	53-70-3	2.5	5
Benzo(g,h,i) perylene	191-24-2	4.0	5
2-Nitroaniline	88-74-4	1.0	20
3,3'-Dichlorobenzene	91-94-1	NA	5

¹ Values in parentheses are estimated.

² N-Nitroso-di-phenylamine and Di-phenylamine are reported as a total of the two compounds.

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Values in parenthesis are estimated.

TABLE G

RESIDENTIAL WELL COMPOUND LIST AND QUANTITATION LIMITS

<u>Pesticides/Aroclors</u>		<u>CAS Number</u>	<u>Quantitation Limits</u>	
	<u>CLP</u>		<u>CRL</u>	
(ug/L)	(ug/L)			
alpha-BHC		319-84-6	0.02	0.01
beta-BHC		319-85-7	0.02	0.01
delta-BHC		319-86-8	0.02	0.01
gamma-BHC (Lindane)		58-89-9	0.02	0.01
Heptachlor		76-44-8	0.03	0.01
Aldrin		309-00-2	0.02	0.01
Heptachlor epoxide		1024-57-3	0.01	0.01
Endosulfan I		959-98-8	0.010	0.01
Dieldrin		60-57-1	0.010	0.02
4,4'-DDE		72-55-9	0.02	0.01
Endrin		72-20-8	0.010	0.02
Endosulfan II		33213-65-9	0.010	0.02
4,4'-DDD		72-54-8	0.04	0.02
Endosulfan sulfate		1031-07-8	0.13	0.02
4,4'-DDT		50-29-3	0.020	0.02
Methoxychlor		72-43-5	0.020	0.10
Endrin ketone		53494-70-5	0.030	0.02
alpha-chlordane		5103-71-9	0.020	0.01
gamma-chlordane		5103-74-2	0.020	0.01
Toxaphene		8001-35-2	1.0	1.0
Aroclor 1016		12674-11-2	0.2	0.2
Aroclor 1221		11104-28-2	0.2	0.2
Aroclor 1232		11141-16-5	0.2	0.4
Aroclor 1242		53469-21-9	0.2	0.2
Aroclor 1248		12672-29-6	0.2	0.2
Aroclor 1254		11097-69-1	0.2	0.2
Aroclor 1260		11096-82-5	0.2	0.2

TABLE H

RESIDENTIAL WELL INORGANIC ELEMENT LIST AND DETECTION LIMITS

<u>Element</u>	<u>CAS Number</u>	<u>CRL</u> <u>Limits</u> (ug/L)	<u>CLP</u> <u>Limits</u> (ug/L)
Aluminum	7429-90-5	80	100
Antimony	7440-36-0	2	5
Arsenic	7440-38-2	0.2	2
Barium	7440-39-3	6	20
Beryllium	7440-41-7	1	1
Cadmium	7440-43-9	0.2	1
Calcium	7440-70-2	500	500
Chromium	7440-47-3	8	10
Cobalt	7440-48-4	6	10
Copper	7440-50-8	6	10
Iron	7439-89-6	80	100
Lead	7439-92-1	2	2
Magnesium	7439-95-4	100	500
Manganese	7439-96-5	5	10
Mercury	7439-97-6	0.1	0.2
Nickel	7440-02-0	15	20
Potassium	7440-09-7	5000	750
Selenium	7782-49-2	2	3
Silver	7440-22-4	6	10
Sodium	7440-23-5	1000	500
Thallium	7440-28-0	2	10
Vanadium	7440-62-2	5	10
Zinc	7440-66-6	40	20
Cyanide	57-12-5	NA	10
Fluoride	UA ¹	NA	200
Total Nitrogen	UA	NA	100

¹ UA is unavailable

3.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The OEPA assumes responsibility for all phases of a Site Assessment or Brownfield investigation. These responsibilities include: field operations, data assessments, HRS scoring, and preparation of SI reports.

The U.S. EPA and the OEPA responsibilities include: program management, quality assurance, field operations, and laboratory operations. The QA/QC and associated procedures for Brownfield investigations are similar to that of the existing site assessment procedures. Any deviations from these established procedures will first be discussed with the appropriate individuals both at Ohio EPA and US EPA Region 5. Any activity that is different from this established criteria will be adequately documented. These responsibilities are discussed below with an organization chart provided in Figure 3-1.

3.1 Program Management Responsibility

These responsibilities involve executing and managing technical and administrative duties as described in the following subsections.

3.1.1 U.S. EPA Region V Early Action Project Manager (EAPM)

This individual will monitor the performance of the OEPA conducting SIs under the PA/SI Cooperative Agreement.

3.1.2 OEPA District Coordinator

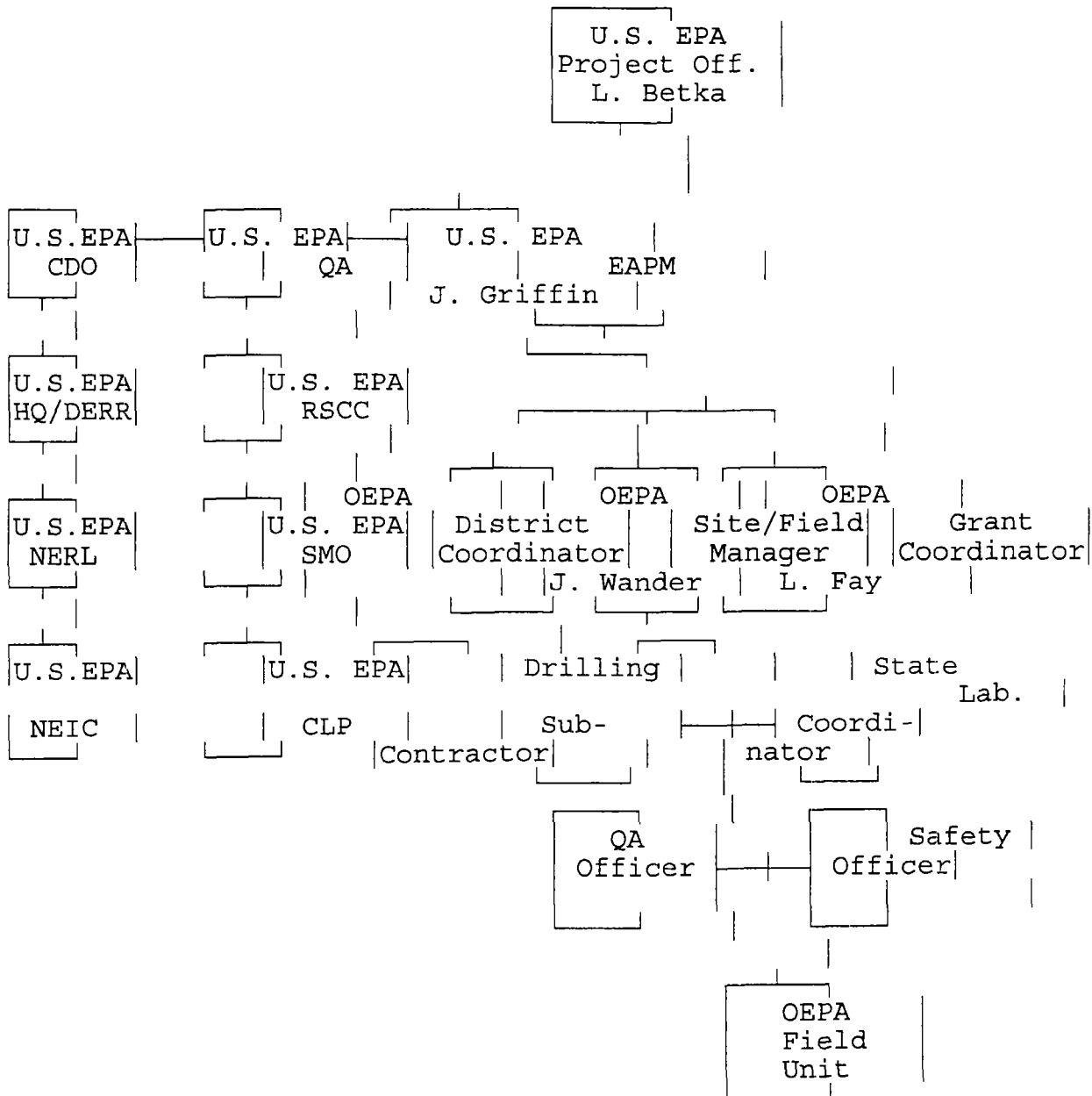
This individual will communicate with the U.S. EPA EAPMs on program and site-specific issues regarding a site in their district.

3.1.3 OEPA Grant Coordinator

This individual will communicate with the U.S. EPA EAPMs on OEPA program issues and grant commitments.

FIGURE 3-1

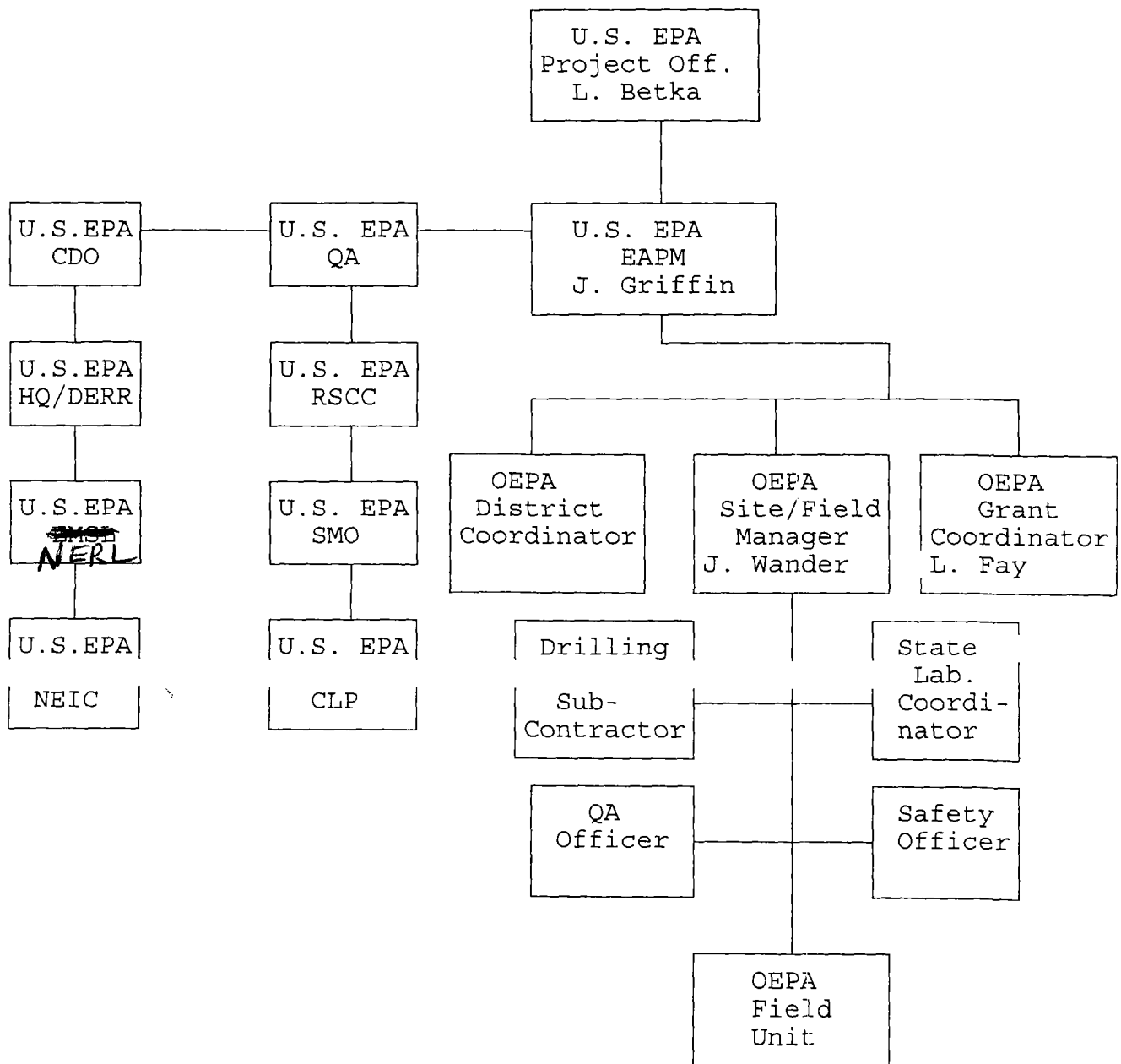
U.S. EPA REGION V AND OEPA
 PRELIMINARY ASSESSMENT/SITE INVESTIGATION COOPERATIVE AGREEMENT
 ORGANIZATIONAL FLOW CHART



Note: Field Unit = all Field Investigators
 Field Investigator = one Field Unit member

FIGURE 3-1

U.S. EPA REGION V AND OEPA
 PRELIMINARY ASSESSMENT/SITE INVESTIGATION COOPERATIVE AGREEMENT
 ORGANIZATIONAL FLOW CHART



Note: Field Unit = all Field Investigators
 Field Investigator = one Field Unit member

3.1.4 OEPA Site/Field Manager

This individual will communicate with the U.S. EPA EAPM on site-specific field operations, HRS scoring, and SI report issues.

3.2 OEPA Site Investigation Field Unit (SIFU)

The SIFU includes the following positions and associated responsibilities:

3.2.1 Drilling Sub-Contractor

These individuals will perform site-specific drilling activities associated with investigations requiring a detailed characterization of soil and ground water contaminants.

3.2.2 Laboratory Coordinator

This individual may communicate with the U.S. EPA RSCC and U.S. EPA SMO to arrange laboratory services and verify sample shipment respectively. This individual may also arrange for analytical services other than CLP using the OEPA contracted laboratory.

3.2.3 Quality Assurance Officer

This individual will monitor and review field QA/QC procedures and documentation to ensure compliance with OEPA and U.S. EPA QA/QC procedures.

3.2.4 Safety Officer

This individual (designated by the Site/Field Manager) will enforce health and safety policies during a specific SI.

3.2.5 Field Unit

These individuals will conduct all data collection activities, measurement activities, HRS scoring, and report generation associated with a SI. They will also communicate with the U.S. EPA RSCC and SMO to arrange for laboratory services and verify sample shipment.

3.3 Quality Assurance Responsibility

The U.S. EPA QA Manager, the OEPA Site/Field Manager, OEPA QA Officer shall review and approve all activities associated with an investigation. Specific QA responsibilities are summarized below:

3.3.1 Final Review/Approval of the SI QAPP and SSWP

The U.S. EPA Region V Qualified Reviewer shall review and approve the final QAPP. U.S. EPA EAPM shall review all SSWP.

3.3.2 Data Validation

The U.S. EPA Region V shall perform all data validation for all CLP RAS/SAS deliverables. Most data will be reviewed by CADRE.

3.3.3 Performance & System Audits

3.3.3.1 Field Audits

External field audits may be conducted by the U.S. EPA Region V. All internal audits may be conducted by the OEPA Site/Field Manager and QA Officer.

3.3.3.2 Laboratory Audits

All CLP RAS laboratories shall be audited by the U.S. EPA Analytical Operations Branch, the U.S. EPA National Environmental Research Laboratory (NERL) Evidence Team, and the U.S. EPA Regional Technical Project Officers.

If Region V RSCC/TPO procures SAS Labs, they will be responsible for any lab audits, review of analytical SOPs and any PE Samples. They will also be responsible for drafting necessary SOWs for these analyses. These audits may include review of available analytical procedures, review of performance evaluation samples, and possibly system audits. SAS analysis can also be procured and potentially audited via established protocols of the DERR Contracting and Grant Unit. Audits are conducted at the discretion of the QA/QC Coordinator or Lab Coordinator.

On-site laboratories shall be externally audited by the U.S. EPA Region V, and internally audited by the Site/Field Manager or QA Officer.

SAS data validation occurs by either the QA/QC Coordinator, Lab Coordinator, or by a contracted third party. Protocols for the data validation are those which are existing in established guidances.

3.3.4 Assessment of Quality Assurance Objectives

The OEPA Site/Field Manager, Field Investigator, or QA Officer, shall assess validated data to determine compliance with U.S. EPA and OEPA QA objectives.

3.3.5 OEPA QA Review & Approval of Reports, Standard Operating Procedures (SOP), and Field Activities

The Site/Field Manager and QA Officer shall review as necessary reports and procedures which may impact data quality for a SI.

The QA Officer shall audit the implementation of the QA program to ensure conformance with the requirements of the project. Status reports will be prepared after completion of the review. All status reports will be reviewed by the Site/Field Manager and kept in the Document Control Center (DCC). The QA Officer will also provide QA technical assistance to SIFU and project staff.

3.3.6 Evidence Audits of Field Records

The OEPA Site/Field Manager, Field Investigator, or QA Officer shall be responsible for evidence audits of all site-specific field records.

These audits may be conducted using the guidelines provided in the NEIC, "Evidence Audit of Enforcement Investigations by Contractor Evidence Audit Teams."

The U.S. EPA RSCC will be receive written notification (within seven days from the

completion of an investigation) concerning any corrections, discrepancies, or problems that occurred during the investigation. A copy of this document will be maintained in the project file located in the OEPA DCC.

3.3.7 Approval of Non-CLP Laboratory Procedures

The U.S. EPA Region V and the U.S. EPA Region V Region QA Manager will approve all non-CLP analytical procedures.

3.4 Field Operations

The OEPA SIFU under direction of the Site/Field Manager will conduct all field activities identified in a SI in accordance with the contents of this QAPP. These activities may include drilling and well development (reference Appendix B), sampling, field sample measurements, sample packaging, and sample custody documents.

The OEPA SSWP describes specific SIFU positions and their responsibilities. This includes the OEPA Site/Field Manager, OEPA Field Unit (responsible for sampling and measurement etc...), QA Officer, and Safety Officer.

3.5 Laboratory Operations

All laboratory analyses shall be conducted through U.S. EPA CLP, or CRL, using RAS and/or solicited SAS services. The Field Investigator(s) under direction of the Site/Field Manager will initiate and schedule the request for analytical services with the U.S. EPA Regional Sample Control Coordinator (RSCC), and prepare all SAS request forms. All SAS request forms will be completed according the instructions provided in the "Guidelines for Preparation of Special Analytical Services Request Forms for Solicitation through the Contract Laboratory Program," U.S. EPA, February 1989. NOTE - the CLP no longer performs SAS, however this guidance is followed when found necessary and appropriate.

All SAS requests forms (see Appendix D) and analytical services must be submitted by the fifteenth day prior to the month of sampling (e.g., sampling on November 20th, request for analytical services must be received by October 15th). One week before the scheduled sampling event contact the U.S. EPA RSCC to confirm the sampling dates.

The U.S. EPA CLASS SMO shall schedule samples for CLP RAS laboratories prior to sample collection. These laboratories

are scheduled according to the sample estimates received from the RSCC.

Occasionally, other types of analytical services may be used (i.e., OEPA contracted laboratory and sub-contractors). The OEPA Laboratory Coordinator shall oversee all analytical service request with OEPA contracted laboratories. The OEPA shall also provide an organizational flow chart and analytical protocols. The SSWP will provide a list of analytical parameters to be performed by the laboratory.

3.6 Brownfield Assessments

All Brownfield (BF) assessments and processes will be conducted similar to existing protocols for site assessments. This includes adhering to the similar SI protocols and established roles and responsibilities. The goal of each BF assessment is to evaluate site conditions as they pertain to guidelines established for the particular program. Any deviations from routine activities associated with BF assessments will be appropriately discussed and documented. For BF assessments, no PREScore will be conducted. Also, the reporting format for BF assessments is different from routine SI's and will reflect the appropriate content associated with BF protocols.

4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Quality assurance objectives (QAO) are intended to ensure that procedures used during a SI will provide results legally defensible in a court of law and data of acceptable quality for evaluating a site.

The following six topics are indicators of data quality objectives (DQO): precision, accuracy, representativeness, completeness, comparability, and sensitivity. The SSWP will describe specific QC samples to be collected during a SI.

These parameters are used to determine the data quality of a project. Precision, accuracy, and sensitivity define the QAO goals for the analytical methods while representativeness, comparability, and completeness define the QAO goals for the data. DQOs will be determined on a individual site basis.

4.1 Precision

Precision is a quantitative term that estimates reproducibility of measurements under a given set of conditions. This estimates the variability of a set of measurements around the mean and can be expressed statistically as the standard deviation, the relative standard deviation (the coefficient of variation), the range or the relative range.

Precision is provided in the RAS SOWs, CRL operational methods, and SAS requests. The U.S. EPA Region V will evaluate data for acceptability. Acceptability is determined after the data have been evaluated for precision requirements applicable to the method and objectives of the SI.

Precision for a set of tests is determined by the analysis of field duplicates, laboratory duplicates, and laboratory MS/MSD. These results are evaluated together to determine the precision for a specific SI. The following equation is an example of how to calculate precision.

$$RPD = |S - D| / [(S + D) / 2] * 100\% \quad \text{Eq. 4-1}$$

RPD = Relative Percent Difference

S = First sample result (MS)

D = Second sample result (MSD)

4.1.1 Types of Duplicate Samples

The OEPA will indicate on the SSWP one of the following types of duplicate samples.

- (a) Collocated samples are independent samples collected at approximately the same location and time, and processed and analyzed by the same laboratory.

Collocated samples are not composited then split into two samples. They are two separate samples from an identical site location. Examples of collocated samples are side by side soil samples (nesting), or two surface water samples collected near the same point in a lake or lagoon.

- (b) Replicate samples are collected at one sampling location and time and divided into two or more portions at the same step in the measurement process. Each portion is then placed into individual containers and given separate sample numbers. Replicate samples are processed and analyzed by the same laboratory

Examples of replicates samples include ground water samples purged from a well then collected in a common container and placed into separate containers, or a soil sample thoroughly homogenized in a stainless steel tray and divided into separate containers.

- (c) Split samples are replicate samples sent to different laboratories for analysis. These samples will be processed and analyzed using the same methodology

(e.g., Solid Waste 846). Split samples are used to assess comparability of the analytical measurement system.

Duplicate samples (collected as one duplicate sample per 10 or fewer investigative samples) provide an estimate of precision for the entire system including transportation, sampling technique, sample homogeneity, and to an extent laboratory performance.

Collocated samples estimate the precision of a data collection activity. Sampling error may be estimated using the results of collocated and replicate samples. This error is determined if a significant difference is found in the precision of the two subsets. The magnitude of the sampling error is evaluated using the two subsets. Bias from compounds/elements, methodology, and matrix should be considered during evaluation of these subsets.

Split samples will be determined on an individual site basis. High concentration samples, oils, sludges, and leachates will not require duplicates.

Duplicate samples will be collected at critical sampling locations to provide adequate QC for a SI. These samples will not be collected in areas visibly saturated with oil or other substances which may interfere with the analyses, or at a sample location designated for a MS/MSD.

Duplicate samples will be identified with a separate CLP number and sample tag. The traffic report will provide a QC qualifier to identify CLP duplicates. Duplicates for CRL will be identified in the sample number (see Appendix C).

4.2 Accuracy

Accuracy is a quantitative term that estimates the bias in a measurement system. Accuracy is difficult to estimate for an entire data collection activity. Sources of error include the following:

- Sampling procedure;
- Field contamination;
- Preservation handling;
- Sample matrix;
- Sample preparation;
- Analytical techniques.

Sampling accuracy may be assessed using the following:

- Field blanks;
- Equipment blanks;
- Field spikes;
- Trip blanks.

Laboratory accuracy may be assessed using the following:

- Laboratory MS/MSDs;
- Surrogates;
- Method blanks;
- Instrument blanks;
- Calibration standards;
- Laboratory check standards.

Accuracy requirements are provided in the RAS SOWs, CRL operational methods, and SAS requests. The U.S. EPA Region V will evaluate data for accuracy. Accuracy will be assessed for acceptability only after the data have been evaluated in relation to the requirements stated in the applicable method and to the objectives of a specific SI.

Please see Tables 3-10 and 3-11 (in this section) for the QA Objectives for both lab and field measurements.

The following equation shows how to calculate for accuracy.

$$\%R = (A - B) / C * 100\% \qquad \text{Eq. 4-2}$$

%R = Percent Recovery

A = Analyte concentration determined from the spike sample.

B = Analyte concentration determined from unspiked sample.

C = Concentration of the spike added to the sample.

The following paragraphs will describe types of field and laboratory samples used to evaluate accuracy.

- (1) **Field blanks** are sample containers of American Society for Testing and Materials (ASTM) Type II water either sealed and transported into the field and opened during sample collection, or filled at the site remaining open during sample collection.

These blanks are used to estimate bias caused by contamination introduced from ambient air during sample collection. Results from these blanks should be compared with those of the method blanks to determine the source of any contamination.

Field blanks may be collected for every twenty or fewer aqueous investigative samples of the same matrix (i.e., ground water and surface water) per analytical parameter (see Table 5-1 for preservative requirements).

- (2) **Equipment blanks** (e.g., rinsate blanks) are the final rinse of ASTM Type II water poured through decontaminated sampling equipment and collected in sample containers for laboratory analysis. These blanks estimate the bias caused by cross-contamination introduced due to inadequate decontamination of sampling

equipment. One equipment blank sample per 10 or fewer investigative samples is collected.

Equipment blanks may be provided for aqueous matrices and high concentration samples at a frequency of twenty or fewer investigative samples per analytical parameter (see Table 5-1 for preservative requirements).

- (3) **Trip blanks** are ASTM Type II water samples (for volatile analysis only) provided per lot of sample vials. These blanks are shipped from the container manufacturer to the field during SI activities and finally to the laboratory for analysis.

Trip blanks are used to estimate bias due to contaminants introduced into the sample during transit.

Trip blanks are included only for water samples. All water samples for volatile analysis will be shipped in the same cooler along with a trip blank; however, if space requirements prevent shipping in one cooler then a trip blank must be included in each cooler of water samples being shipped for volatile analysis (trip blanks and investigative samples of the same container lot number will be shipped together).

- (4) **Field spikes** are investigative samples spiked with a known concentrations of the compounds/elements of interest to determine possible bias resulting from environmental, biological, and matrix factors interacting with the analytes of interest during transit. The OEPA will not be submitting field spikes for any SI conducted under the PA/SI Cooperative Agreement.
- (5) **Method blanks** are ASTM Type II water (for water samples) prepared with a batch of

investigative samples to monitor the introduction of laboratory artifacts during the entire analytical procedure. The RAS SOWs, the CRL operational methods, and SAS request discuss method blank criteria and the corrective action procedures that must be implemented when outliers are identified.

- (6) **Instrument blank** is a volume of clean solvent (CLP Pesticides/PCBs only) spiked with surrogates, or acidified ASTM Type II water (for metals). These blanks are used to determine levels of contamination associated with the instrument as a result of sample or standard carry-over.
- (7) **Matrix spike/Matrix spike duplicate**, the laboratory spikes an investigative sample with known quantities of specific compounds/elements then subject it to the entire analytical process. Results of these samples are used to estimate matrix bias and evaluate method precision.

The OEPA will identify every twenty or fewer RAS/SAS investigative samples of the same matrix per analytical method for a MS/MSD. High concentration samples, oils, and leachates will not require a MS/MSD.

Residential well samples analyzed by CLP will require a MS/MSD for the inorganic portion only. CRL requires only a MS/MSD on the organic fraction.

Samples will be identified for a MS/MSD on the sample tags and accompanying traffic report. Soil and sediment samples identified for a MS/MSD will not require additional sample volume, but water samples will require additional volume. All sample volumes and associated containers are provided in Section 5, Table 5-1 of this document.

- (8) **Surrogates** are halogenated or isotopically

labelled compounds (not found in environmental media) added to samples (i.e., blanks, standards, investigative samples) to evaluate analytical efficiency and possible matrix bias.

- (9) **Performance evaluation samples** are solvents/reagents (a.k.a., blind samples) spiked with known quantities of specific compounds/elements then subject it to the entire analytical process to evaluate laboratory accuracy and precision for a given method or set of methods.

The OEPA will not submit blind samples under the PA/SI Cooperative Agreement. The U.S. EPA will be responsible for distributing and monitoring performance evaluation samples associated with SI.

4.3 Representativeness

Representativeness is a qualitative term that expresses the degree to which sample data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It estimates the quality of the sampling design and indicates whether sufficient samples were collected at proper sampling locations. These data will be reviewed to verify that representativeness has been met for the QAOs of a specific SI.

Representativeness involves describing sampling techniques and the rationale used to select sampling locations. Sampling locations can be biased (based on existing data, instrument surveys, observations, etc...) or unbiased (completely random or stratified-random approaches). The rationale used to determine sampling locations must be explicitly explained. These objectives will be evaluated as necessary by the OEPA Site/Field Manager and U.S. EPA Region V.

The OEPA will collect grab samples unless stated otherwise in the SSWP. Soil samples will be homogenized after

collection of the VOC portion (refer to Appendix A, FSOP 7.01).

Background samples will be collected to assess naturally occurring analytes characteristics to the site and pathways of concern. These samples will be of the matrix characteristic to the site/pathway and will attempt to be collected outside the zone of contamination.

4.4 Comparability

Comparability is a qualitative term that expresses the confidence with which one data set can be compared with another. The goal of all data use is that sample data be comparable with other data collected from comparable samples independent of laboratory personnel, data reviewers, and sampling personnel.

Attention must be given to the use of standard procedures to collect and analyze samples including method detection limits, and methods of choice to achieve comparability. This objective will be evaluated as necessary by the U.S. EPA Region V.

4.5 Completeness

The OEPA defines completeness as "the number of samples required for characterization" compared to "the amount of data expected under normal conditions." The OEPA requires total data completeness of 90% or better.

Field completeness is defined as "the actual number of samples collected" compared to "the number of samples planned." Field completeness should be 90% or better. The following equation shows how to calculate for field completeness.

$$\text{Completeness} = \frac{\text{\# of Samples Collected}}{\text{\# of Samples Planned}} * 100\% \quad \text{Eq. 4-3}$$

Laboratory completeness is defined as "a measure of the amount of data obtained from a measurement process" compared to "the amount of data that was expected to be obtained." Laboratory completeness should be 95% or better for all environmental samples submitted for analysis.

4.6 Sensitivity

Sensitivity for SI data will be based on the appropriate field and laboratory detection limits. These limits may be confirmed by analysis of a matrix spike, method blanks, or calibration checks.

NOTE: The QA limits for all laboratory and field analytes are provided in the laboratory-specific QAPP and specific SOP's (both OEPA and manufacturer) for the field measurement equipment.

TABLE 3-10
QA OBJECTIVES FOR FIELD MEASUREMENTS

PARAMETER	METHOD ⁽¹⁾ REFERENCE	PRECISION ⁽²⁾	ACCURACY ⁽³⁾	COMPLETENESS
WATER				
Standing Water Levels	Solinist Water Level Indicator	±0.01 ft.	0.005 ft.	95%
Temperature	E170., Mercury Thermometer or Electronic Temperature Probe	±0.5°C	1.0°C	95%
Conductivity	E120.1, Electrometric	±25	10 umho/cm ²	95%
pH	E150.1, Electrometric	±0.1 pH units	0.05 pH units	95%
Turbidity	E180.1	10 NTU ⁽⁴⁾	0.5 NTU ⁽⁴⁾	95%
Redox Potential	ASTM 1498-93	±10mV	10. mV	95%
Dissolved Oxygen	SM-A4500	±0.05 mg/L	±0.1 mg/L	95%
SOIL				
Bulk Density	ASTM D-1556	NPM	NPM	95%
Soil pH	SW-9045	±0.1 pH units	0.05 pH units	95%

NOTES:

1. Methods: E - Method for Chemical Analysis for Water and Wastes (U.S. EPA, 1983).

SW - Test for the Evaluation of Solid Waste, SW-846, U.S. EPA, September 1986.

SM - Standard Methods for Examination of the Water and Wastewater, 18th ed. (APHA, 1992).

ASTM - Annual Book of ASTM Standards, American Society of Testing and Materials, 1995.

2. Expressed as the acceptable deviation from the Scale.
 3. Expected based on equipment manufacturer specifications.
 4. Acceptable accuracy and precision based on the range of measured. NTUs (nephelometric turbidity units).
- NPM - Not Part of Method.

TABLE 3-11

QA OBJECTIVES FOR LABORATORY PARAMETERS

Matrix Spike Recovery and Relative Percent Difference Limits (RPD)				
	%Recovery		%RPD	
	Water	Soil	Water	Soil
Volatile Organic Compounds				
1,1-Dichloroethene	61-145	59-173	14	22
Trichloroethene	71-120	62-137	14	23
Benzene	76-127	66-142	11	21
Toluene	76-125	59-139	13	21
Chlorobenzene	75-130	60-133	13	21
Pesticides/PCBs				
γ -BHC (Lindane)	56-123	46-127	15	50
Heptachlor	40-131	35-130	20	31
Aldrin	40-120	34-132	22	43
Dieldrin	52-126	31-134	18	38
Endrin	56-121	42-139	21	45
4,4'-DDT	38-127	23-134	27	50
Semivolatile Organic Compounds				
Phenol	12-110	26-90	42	35
2-Chlorophenol	27-123	25-102	40	50
1,4-Dichlorobenzene	36-97	28-104	28	27
N-Nitroso-di-N-propylamine	41-116	41-126	38	38
1,2,4-Trichlorobenzene	39-98	38-107	28	23
4-Chloro-3-Methylphenol	23-97	26-103	42	33
Acenaphthene	46-118	31-137	31	19
4-Nitrophenol	10-80	11-114	50	50
2,4-Dinitrotoluene	24-96	28-89	38	47

Pentachloropheneol	9-103	17-109	50	47
Pyrene	26-127	35-142	31	36

5.0 SAMPLING PROCEDURES

The OEPA FSOPs (see Appendix A) will be used during an investigation to complete the various sampling and field measurements required during an investigation. All FSOPs used during a SI will be included in the SSWP.

Groundwater samples collected for metals analysis will utilize low flow sampling methods. Filtration of samples will not occur unless absolutely necessary. Total metals will use a 5 micron filter, while other samples will utilize a .45 micron filter. A .45 micron filter will most routinely be utilized. If samples are collected for metals and will be filtered, filtration will occur within fifteen minutes from collection; however, organic and cyanide are not filtered after collection. Filtered samples will be given a unique sample number and sample tag, these samples will be identified as filtered samples on the traffic report, but will be identified in the field logbook. The procedure used for filtering is provided in Appendix A, FSOP 5.05.

Additional sample volume will be collected for water matrices identified for a MS/MSD. Soil and sediment samples will not require additional volume.

Soil and sediment samples collected for the analysis of volatile organic compounds (VOC) will be grab samples, the remaining sample will be homogenized according to the procedure provided in Appendix A, FSOP Sections 7 and 9.

Aqueous samples collected for the analysis of VOCs will also be grab samples. If stratification exist within the remaining sample, aqueous homogenization will be performed according to the procedure provided in Appendix A, FSOP Section 4.

Samples collected during a SI may be routinely analyzed for the following CLP parameters: VOCs, semi-volatile organic, pesticides/polychlorinated biphenyls (PCB), metals (23), and cyanide. Some SIs may require SAS requests, all parameters requested for a site will be included in the SSWP. Please note that samples are collected in the order as they appear in this paragraph.

The following tables provide a guideline for sample

containers, preservatives, holding times (RAS, high concentration samples, dioxins, RAS/SAS, CLP and CRL residential well samples), and QC requirements (see Table 5-1)

NOTE: The bottle distribution provided in Table 5-1 covers a broad range of sampling conditions and may not be performed at a particular site.

TABLE 5-1
 BOTTLE DISTRIBUTION
 ROUTINE ANALYTICAL SERVICES

<u>Analysis</u>	<u>Sample Concentration Level</u>	<u>Aqueous Container</u>	<u>Solid Container</u> (wide-mouth)	<u>Preservative</u> ²	CLP-RAS Holding Times ¹ from Verified Time of Sample Receipt	
					<u>Aqueous Sample</u>	<u>Solid Sample</u>
Extractables (Acid Base Neutral (ABN), Pest/PCBs)	Low/Medium	4, 1L Amber G ³	1, 8 oz. G	Cool 4°C	Extract w/in 5 days, analyze in 40 days	Extract w/in 10 days, analyze in 40 days
Volatiles	Low/Medium	2, 40 ml G vial	2, 4 oz. G	Cool 4°C, HCl to pH<2	10 days	10 days

¹ Holding times, preservatives, and containers will be specified in the SSWP for methods excluded from these tables. Holding times are from sampling to extraction or analysis, unless otherwise noted.

² Preservatives are for aqueous samples; soil samples will be cooled.

Preservative Key:

HCl = Hydrochloric acid;
 HNO₃ = Nitric acid;
 NaOH = Sodium hydroxide.

³ G = glass.

TABLE 5-1
 (cont.)

BOTTLE DISTRIBUTION
 ROUTINE ANALYTICAL SERVICES

<u>Analysis</u>	<u>Sample Concentration Level</u>	<u>Aqueous Container</u>	<u>Solid Container</u>	<u>Preservative</u>	CLP-RAS Holding Times from Verified Time of Sample Receipt	
					<u>Aqueous Sample</u>	<u>Solid Sample</u>
Metals	Low/Medium	1, 1L HDPE ⁴	1, 8 oz. G	Cool 4°C HNO ₃ to pH<2	180 days/ 26 days Hg	180 days/ 26 days Hg
Cyanide	Low/Medium	1, 1L HDPE	1, 8 oz. G	Cool 4°C NaOH to pH>12 1.2g ascorbic acid	12 days	12 days

HIGH CONCENTRATION SAMPLES

Organic/ Inorganics/ Dioxin	High	1, 120 ml vial ⁵	1, 4 oz. G	Cool 4°C	None Established	None Established
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⁴ High density polyethylene bottle.

⁵ Substitute glass containers (equivalent volume) may be used, and will be specified in the SSWP.

TABLE 5-1
 (cont.)

CLP and CRL RESIDENTIAL WELL BOTTLE DISTRIBUTION
 SPECIAL ANALYTICAL SERVICES

<u>Analysis</u>	<u>Sample Concentration Level</u>	<u>Aqueous Container</u>	<u>Preservative</u>	Holding Times from Verified Time of Sample Receipt
				<u>Aqueous Sample Holding Times</u>
Volatiles	Low/Medium	3, 40 ml vials No headspace	Cool 4°C; HCl to pH<2	10 days
ABNs	Low/Medium	1, 1L Amber Completely full	Cool 4°C	Extract w/in 5 days Analyze w/in 40 days
Pesticides/PCBs	Low/Medium	1, 1L Amber Completely full	Cool 4°C	Extract w/in 5 days Analyze w/in 40 days
Metals	Low/Medium	1, 1L HDPE	Cool 4°C HNO ₃ to pH<2	180 days (26 days for Mercury)
Cyanide	Low/Medium	1, 1L HDPE	Cool 4°C NaOH to pH>12 ⁶	12 days
(CLP)			10 ml K ₂ Cr ₂ O ₇ & HNO ₃ solution ⁷	

5.1 Packaging Requirements

Samples will be shipped in metal containers for all high concentration, medium concentration, and dioxin samples. The outside of these containers will be labeled with the number of samples inside, the appropriate shipping codes and manifest (i.e., Department of Transportation (DOT), flammable, oxidizers labels etc...). The U.S. SMO or "The Guide to the Federal Hazardous Materials Transportation Regulatory Program," U.S. DOT will provide additional information on sample shipping.

All low level samples shall be placed in sealable plastic bags and wrapped in bubble wrap to prevent breakage. Samples will be shipped in ice chests and cooled (if necessary). These coolers may also be packed with a non-combustible absorbent packing material.

Traffic Reports, Dioxin Shipment Records, SAS Packing Lists, Chain of Custody Forms, and other shipping/sample documentation accompanying the samples will be enclosed in a waterproof plastic bag and taped to the underside of the cooler lid.

Sample coolers will be sealed with the U.S. EPA Region V custody seals (numbered) and covered with clear strapping tape to prevent damage. These seals will be placed so that if the cooler was opened the seals would be damaged. Samples (RAS only) identified for a MS/MSD will require double the investigative sample volume specified for extractables, triple the investigative sample volume for volatiles, and double the investigative sample volume for inorganics.

The Traffic Report will indicate the number of QC samples (i.e., MS/MSD, field blanks, field duplicates), case number and/or SAS number, if the shipment for the case is complete, matrix, preservatives, container lot numbers, carrier tracking number, custody seal numbers, sample numbers, sample tag numbers, sampler(s) name, regional information, site name and location, laboratory name and address, type of field activity, requested parameter(s), split samples requested, sign-off, NPL number or spill code in the associated cooler.

NOTE: CLP/CRL requires a 3rd party air-bill for return of coolers. This form is typically enclosed in the cooler with the chain of custody. Ed Link routinely writes nice notes to the lab on these forms. A copy of this form is included in the hard copy of this QAPP.

5.2 Sample Labeling and shipment

U.S. EPA's Central Regional Laboratory (CRL):

Sample labels will be attached to each individual sample bottle. Sample tags are not required for Brownfield projects. The label will include the field sample number, date/time of collection, type of analysis, sampler initials, and project name. Labels will be annotated with waterproof, permanent ink. CRL sample numbers will be written or pre-printed on the sample labels. CRL sample numbers will be assigned as needed for this project, and will be obtained from the US EPA (Jan Pels at this time). Generally, the CRL sample numbers are in the form of a 9 digit number, such as 00BF04S01. The '00' indicates the US EPA fiscal year in which the samples are collected. The code 'BF' has been assigned to the Brownfield program pilots. The remainder of the number is a sequential number assigned by USEPA such that each sample number is unique. Field blanks and trip blanks will be identified by coding the samples with an 'R' in place of the 'S'. Water field duplicate samples will be identified by the CRL sample number by substituting a 'D' in the same sample number, e.g., 00BF04S01 and 00BF04D01 would be field duplicates. If the CRL is too scheduled to analyze samples, a block of CRL sample numbers will be assigned (i.e. 00BF04S01-S99). The first sample would be 00BF04S01, the next would be 00BF04S02, etc. The project consultant will keep track of which CRL log numbers assigned are used and will request more sample numbers if needed. Sample numbers not used will be returned to USEPA for use with another project. Beginning on Oct. 1, 1999, the fiscal year 2000 begins, and sampling numbers will be assigned with the following format: 2000BF01S01.

Samples shipped to the CRL will be documented on a Chain of Custody (COC) form (see attached example in this section). The COC form will be filled out as in the example, including the site name, sampler

names/signatures, time/date of sampling (military time), type of sample, CRL sample number, the field station location, analyses requested will be listed in the right hand columns, the numbers of the COC seal numbers on the cooler, airbill number. The completed COC form should be enclosed in a ziplock baggie taped to the inside lid of the cooler that contains the samples listed on the form. The CRL shipping Address is;

Bill Sargent
US EPA, Region 5
Central Regional Laboratory
536 S. Clark St.
10th Floor
Chicago, IL 60605
(312) 353-9083

NOTE: Call Bill Sargent at the number above daily after shipment to the CRL, with airbill number, number of samples shipped, matrix, analyses requested, etc. Bill Sargent can be contacted concerning return shipment of empty coolers.

Example of CKL - Chain of Custody

REGION 5
77 West Jackson Boulevard
Chicago, Illinois 60604

CHAIN OF CUSTODY RECORD

[illegible]

6.0 SAMPLE CUSTODY PROCEDURES

The U.S. EPA Region V sample custody and chain-of-custody (COC) procedures are described in the "NEIC Policies and Procedures," U.S. EPA-330/9-78-001-R, June 1985.

A sample or evidence file is under the custody of an employee if it:

- is in the employee's possession;
- is in the employee's view, after being in their possession;
- was in the employee's possession and the employee placed them in a secured location, or;
- is in a designated secure area.

6.1 Field Chain-of-Custody Procedures

The sample packaging and shipment procedures summarized below will insure that samples will arrive at the laboratory with the COC intact. Appendix C provides examples of all CLP and CRL sample documentation procedures and forms.

6.1.1 General Field Procedures

(a) The field sampler is responsible for the care and custody of the samples until they are transferred or properly shipped.

(b) All bottles are labelled with CLP adhesive labels (RAS & SAS only), CRL drinking water samples will have a separate CRL number, all samples (RAS, SAS, CRL) will have a sample tag specifying sample location, date, time, parameter, sample number, matrix, sampler initials, Case number/SAS numbers. The CLP adhesive labels and sample tags will be provided by the U.S. EPA Region V RSCC. See Appendix C for example.

(c) Sample tags are to be completed using waterproof ink unless prohibited by weather conditions. If pencil is used, this will be documented in the field logbook. NOTE - for Brownfield Assessments, sample tags are not required for CRL/CLP assessments.

(d) The Site/Field Manager will review all field activities to determine whether field protocols were followed during the investigation.

6.1.2 Field Logbooks

The field logbook will provide the means of recording data collection activities. Such entries will describe in detail so that persons going back to the site could re-construct prior investigatory activities.

Field logbooks, survey books, and notebooks will be paginated and stored in the DCC.

Application of associated activities will also adhere to established protocols located in Sections 2 and 3 of the DERR FSOPs.

The title page of each field logbook will contain the following:

- * Project name;
- * County;
- * CERCLIS identification number;
- * OEPA identification number;
- * Beginning sampling date;
- * Ending sampling date;
- * Investigation team.

Logbook entries for samples will contain the following information:

- * Sample number;
- * Date and time of sample collection;
- * Sample collectors;

- * Description of sampling location;
- * Depth of sample location;
- * Sample type (e.g., grab, composite, background etc...);
- * Map of sample locations;
- * Sample matrix;
- * Field observations;
- * Photograph frame number;
- * Field measurements (e.g., temperature, pH, radioactivity etc...);
- * Sample volumes collected, preservatives, and parameters requested;
- * FSOPs used during sample collection;
- * FSOP deviations and corrective actions;
- * Container lot numbers;
- * Sample tag traffic numbers;
- * Identification of QC samples;
- * Visitors names;
- * Levels of protection (as necessary);
- * Documenters signature and QA reviewers signature;
- * Address and names of residences (for drinking water samples only).

All incorrect entries will be crossed-out with a single line, dated and initialed.

6.1.3 Transfer of Custody and Shipment Procedures

Sample custody and shipment procedures are provided in Appendix C.

6.2 Laboratory Chain-of-Custody Procedures

6.2.1 Contract Laboratory Program Procedures

The CLP SOWs for RAS describe laboratory COC procedures. The same custody procedures apply to SAS. These custody procedures are provided in the CLP SOWs for Organic

Low/Medium Concentration (OLC02.1) and
Inorganic Low/Medium Concentration (ILM04.0).

6.2.2 Central Regional Laboratory

The CRL has its own custody scheme for specifically designed for drinking water samples. These procedures are in revision and will be updated upon receipt of the guidance.

6.3 Custodian Procedures for Final Evidence Files

The OEPA will be the custodian of all evidence files and will maintain the contents of these files for all SI activities. The OEPA will maintain SI files along with all relevant records, PA reports, safety reports, logs, field notebooks, pictures, subcontractor reports, and U.S. EPA Region V data reviews.

These documents will be kept in a secured, limited access DDC for all active investigations. Evidence files will be relinquished to the U.S. EPA Waste Management Division at the close of each investigation.

All original CLP and CRL laboratory records are maintained under the custody of the U.S. EPA Region V CRL in accordance with the procedures outlined in all active SOWs.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all instruments and measuring equipment used for conducting field tests and laboratory analyses. These instruments and measuring equipment will be calibrated prior to each use and will be serviced by the manufacturer on a scheduled basis. Specific calibration procedures, verification and potential continuing calibration checks are outlined in the specific DERR Field Standard Operating Procedure (FSOP) for that instrument. FSOPs are located in each vehicle that is used for field work and therefore available on-site if needed.

7.1 Field Instruments/Equipment

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated frequently to ensure that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

Field sample equipment is examined to ensure that it is in operating condition. This includes checking the manufacturer's operating manual and the instruction for each instrument to ensure that all maintenance requirements are being implemented. Field notes from previous investigations are reviewed to identify any prior equipment problem(s) that require maintenance. If anomolous reads occur while the particluar instrument is in use, measures will be taken to trouble-shoot the problem (instrument-specific) and re-calibrations will occur.

Field instruments are calibrated at intervals specified by the manufacturer or at least daily before field measurements are taken. Field instruments may include: pH meter, temperature/level/conductivity meter, portable gas chromatograph, organic vapor analyzer, and combustible gas indicator. If an instrument fails to meet calibration criteria, it will be sent to the manufacturer for service.

All instruments will be calibrated according to the procedures provided in Appendix A. Each instrument logbook will contain the following information:

- * Calibration gases/solutions and associated lot numbers;
- * Calibration results;
- * Calibration date and time;
- * Calibrator's initials.

Spare electrodes, batteries, calibration solutions, and maintenance equipment will be taken into the field during a SI.

7.2 Laboratory Instruments

All CLP calibration procedures and frequencies are described in the RAS organic and inorganic SOWs. SAS calibration and frequencies are described in the SAS request. While CRL calibration protocols are described in the CRL operational methods. All contracted laboratory services require that the lab submit both a QAPP and accompanying Standard Operating Procedures for their methods and instrumentation. These required documents contain the information pertinent to initial calibrations for each instrument, initial calibration verifications, and language discussing continuing calibrations.

8.0 ANALYTICAL PROCEDURES

Analytical services requested for SIs include CLP RAS.

8.1 Low and Medium Concentration Samples

8.1.1 Routine Analytical Services

The RAS SOWs Organic Low and Medium Concentrations Media (OLM03.2) and Inorganic Low and Medium Concentrations Media (ILM03.0) will be used for the analysis of TCL and TAL for low and medium concentration samples.

8.1.2 Special Analytical Services

Low and medium concentration samples will be analyzed for SAS parameters as solicited by the Region V USEPA/RSCC or at the direction of Ohio EPA.

8.2 High Concentration Samples

8.2.1 Special Analytical Services

High concentration samples will be analyzed using High Concentration Organic Analysis (SOW-9/88, revised 1/89 and 4/89). For inorganic high concentration samples SOW Inorganic High Concentration Media (IHCO1.2) will be used.

High concentration samples will be analyzed for SAS at the solicitation by Region V USEPA/RSCC or by the Ohio EPA.

8.3 Drinking Water Samples

8.3.1 Central Regional Laboratory

This lab will routinely provide analysis for metals and cyanide for Drinking Water samples and occasionally Organics in Drinking Water.

8.3.2 Contract Laboratory Program Drinking Water Analysis

Drinking water samples may be shipped to CLP laboratories for organic analysis. These samples may be analyzed using RAS SOW Organic Low Concentration Media (OLC02.1). Invitation for Bid (IFB) are pending for low level inorganics, all SOWs will be updated when guidance becomes available.

9.0 INTERNAL QUALITY CONTROL CHECKS

9.1 Field Sample Collection

Field sampling precision and accuracy may be assessed by the collection of field duplicates and field blanks (at a minimum). All sample collection activities will be performed in accordance with the OEPA FSOPs (provided in Appendix A) and this document. All QC checks will be recorded in the instrument logbooks and field logbooks. Site-specific QC samples will be specified in the SSWP. Utilization of Direct Push Technology (GeoProbe) and certain field screening activities will also occur with a minimum of 10% of samples being sent for fixed-based laboratory analysis and confirmation.

9.2 Field Measurement

Multiple readings of a single sample or standard are used to determine how reproducible a measurement system is for a specific instrument.

9.3 Laboratory Quality Control Checks

The RAS SOW specified the types, acceptance criteria, and the frequency of QC checks to be performed for a specific method. These QC specifications may include any of the following:

- * Method blanks;
- * MS/MSDs;
- * Calibration standards, internal standards, and surrogates;
- * Calibration check standards;
- * Laboratory duplicates/replicates;

All CRL analyses will follow the CRL's operational procedures for types, frequency, and QC acceptance criteria.

All SAS QC checks are identified in the QC requirements of the SAS requests.

10.0 DATA REDUCTION, VALIDATION, AND REPORTING

10.1 Data Reduction

10.1.1 Field Measurements and Sample Collection

Field personnel shall record all field measurements and sample collection activities in a field logbook. This information may be used in project reports if so, a summary of the information and method of reduction will be provided in the report.

10.1.2 Laboratory Services

All samples collected at a site will be submitted for CLP (RAS) analysis. These samples must include sample location identification number when submitted to the Region Lab. Data reduction, evaluation, and reporting will follow the specification outlined as a part of the Computer-Aided Data Review and Evaluation (CADRE) software (Note: OLC does not currently include the CADRE deliverable). After analysis, the data will be submitted to the U.S. EPA Region V for validation.

The average turn-around-time from receipt of the last sample into the laboratory to data validation from the U.S. EPA is fifty-six days (plus three to five days for delivery time).

Drinking water samples analyzed by US EPA Region V will be reduced and validated according to specifications outlined in the US EPA operation- al procedures.

10.2 Data Validation

Data validation will be performed by comparing the results of the sample data packages and QA/QC results to the requirements stated in RAS methodologies. The U.S. EPA Region V will be responsible for this function

and utilize the CADRE software program to review most of the site assessment and Brownfields data.

Raw data such as Gas Chromatography/Mass Spectrometry (GC/MS) mass spectra print-outs, GC print-outs, ICAP data station print-outs are compared with data reports to determine if reported results are accurate.

The following are documents/programs that provide guidelines for conducting data validation.

"USEPA CLP National Functional Guidelines for Organics Data Review", February 1994.

"USEPA CLP National Functional Guidelines for Inorganics Data Review", February 1994.

Computer-Aided Data Review and Evaluation (CADRE) software.

The OEPA Laboratory Services Coordinator shall be responsible for data validation of all non-CLP laboratory data, unless the data is procured via the SAS, then the SAS will implement a data validation.

10.3 Data Reporting

All CLP RAS laboratories will prepare and submit full analytical and QC reports to the U.S. EPA Region V to comply with CLP deliverable requirements. Components of CLP deliverables are provided in the RAS inorganic and organic SOWs, SAS and CRL deliverables will provide all raw data and data reports.

11.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify compliance with established procedures. These audits will be both external and internal.

11.1 Field Audits

Internal audits of field activities (sampling and measurements) will be conducted by the Site/Field Manager and QA Officer. These audits will examine instrument maintenance records, calibration logbooks, and field logbooks to assess compliance with FSOPs and QA/QC protocols.

Record audits will occur during and at the completion of an investigation to evaluate sample/field/instrument anomalies and QA/QC protocols.

All corrective action procedures will be documented in the field logbook or instrument logbook. Future audits will review previously documented deficiencies to verify if corrective action procedures and QA procedures were implemented.

External audits will be conducted by U.S. EPA Region V or a U.S. EPA representative.

11.2 Laboratory Audits

Laboratories participating in CLP are routinely audited by the U.S. EPA NERL. In addition, the U.S. EPA may conduct audits of SAS laboratories. These audits will consist of system audits on an annual basis and performance audits on a quarterly basis.

System audits include the examination of laboratory sample custodian documentation (i.e., sample storage, log-in, COC procedures etc...), analytical processes (i.e., sample digestion/extraction, analysis), sample control within the laboratory, instrument maintenance records, standard preparation logbooks, sample preparation logbooks, and sample analysis logbooks.

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Performance audits include the analysis of performance evaluation samples (blind samples) submitted by the U.S. EPA to assess laboratory precision and accuracy. These results are evaluated by the U.S. EPA to ensure that a laboratory maintains good performance.

12.0 PREVENTIVE MAINTENANCE PROCEDURES

12.1 Field Equipment/Instruments

Field equipment used for conducting SIs include portable pH meter, combustible gas indicator, temperature/conductivity/level meter, Microtip (photo-ionization detector), radiation meter, and HNU (flame ionization detector). Manufacturers recommended preventive maintenance procedures will be followed by the OEPA.

All instruments will be calibrated prior to each use and at regularly scheduled intervals. Instrument calibrations will occur at the beginning and ending of each day during an investigation, or as conditions dictate. All calibration solutions and lot numbers, calibration date and time, calibration results, and calibrator's initials will be recorded in the instrument logbook.

Critical spare parts such as: pH probes, electrodes, filters, batteries, and any additional maintenance part will be kept on-site to minimize instrument down-time.

12.2 Laboratory Instruments

12.2.1 Contract Laboratory Program Laboratories

All laboratories participating in CLP are required under the CLP RAS SOWs for inorganics and organics and SAS to have preventive maintenance SOPs for each measurement system. All maintenance activities are required to be documented in the instrument maintenance log books.

12.2.2 Central Regional Laboratory

All laboratory instruments will be maintained according CRL operational methods.

13.0 CORRECTIVE ACTIONS

Sampling problems may develop from sampling procedures, improper sample handling, and instrument malfunctions. Corrective actions may be required for analytical and sampling problems. Analytical corrective actions are stated in the RAS inorganic and organics SOWs, SAS request forms, and CRL operational methods.

13.1 Sample Collection/Field Measurements

Corrective action procedures will be implemented when a problem is identified. Field personnel will be responsible for reporting all sampling and instrument problems to the Site/Field Manager and QA Officer. All corrective actions will be implemented by field personnel according to the Site/Field Manager instructions. These procedures will be implemented in accordance with the QAPjP and recorded in the field logbook.

The Site/Field Manager will evaluate situations that may impact the quality of the data. If the situation warrants a nonconformance report will be initiated and accompany the SI report.

Corrective action procedures for field measurements may include the following:

- * Repeat the measurement to check for error;
- * Recalibrate instruments;
- * Check batteries, probes, filters;
- * Replace instrument or measuring devices;
- * Stop work (if necessary).

The Site/Field Manager is responsible for all site activities. These responsibilities include modifying SSWP to accommodate site specific needs. All changes made in the SSWP will be documented in the site's field logbook. Some SSWP modifications will require approval from the U.S. EPA EAPMs.

13.2 Laboratory Analyses

Corrective action procedures are provided in the RAS inorganic and organic SOWs, laboratory established QA/QC

protocols, SAS requests, and CRL operational methods. These procedures are implemented a several different phases in the analytical process. Laboratories participating in CLP are required to have written laboratory SOPs and QA/QC protocols to identify an outlier and implement the necessary corrective action at that level.

The U.S. EPA SMO may request corrective actions for any contractual nonconformance identified during an audit or data validation process. The CRL may also request corrective action by laboratories for any nonconformances identified in the data validation process through the U.S. EPA SMO. Corrective action may include the following:

- . Re-analyze samples, if holding time permits;
- . Resample;
- . Amend analytical procedures to correct the problem;
- . Accept data and acknowledge the level of uncertainty.

If resampling is required due to laboratory anomalies, the U.S. EPA EAPMs will notify the Site/Field Manager.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

A Quality Assurance Report will be generated on a quarterly basis, or if problems occur during the project which would result in resampling or impact the quality of the data. Samples may be recollected due to sample contamination, lower detection limits, preservation anomalies, or broken containers. The content of the reports will discuss performance of sample crews (i.e. following established SOPs, following the established work plan, etc.), and potential problems encountered and how they were rectified. The report will also provide a description of any re-sampling event, should such an event occur. Copies of this report will be made available, upon request, to the EPA Early Action Project Manager.

15.0 CERTIFICATION OF CONTAINER CLEANLINESS

All containers will have a certificate of cleanliness for each lot of sample containers dedicated to a specific analysis. The OEPA will follow the guidelines provided in the "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers," April, 1992, OSWER Directive #9240.0-05A. A certificate verifying container cleanliness will be provided by the container manufacturer and retained in the OEPA DCC along with the associated site files. Monitoring blank samples will routinely be collected to verify that sample containers are indeed clean. The most commonly collected blanks will be field and trip blanks. As a routine part of the sample collection process, these QA samples will add confidence that sample containers are clean for use. Bottle blanks will also be collected, at random, from a "lot" of sample containers. The number of bottle blanks collected will 5% of the total number of sample containers for the associated "lot". The goal in collection of these blanks will verify that containers are clean and avoid the potential for continued use of contaminated sample bottles.

16.0 REFERENCES

"CLP Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration," U.S. EPA, Document OLM03.2 with revisions.

"CLP Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration," U.S. EPA, Document ILM03.0 with revisions.

"CLP Statement of Work for Organic Analysis, Multi-Media, High Concentration," U.S. EPA (with revisions 9/88, 4/89, and 8/89 - or most recent version)

"CLP Statement of Work for Inorganic Analysis, Multi-Media, High Concentration," U.S. EPA, Document IHC01.2 - or most recent version.

"User's Guide to CLP," U.S. EPA, December 1988 (or most recent version).

"Management of Investigation-Derived Wastes During Site Inspections," U.S. EPA/540/G-91/009, May 1991.

"Hazard Ranking System; Final Rule," U.S. EPA Federal Register, 400 CFR Part 300, Vol. 55, No. 241, December 1990.

"Data Quality Objectives for Remedial Response Activities," U.S. EPA/QA/G-4, Sept. 1994.

"NEIC Policies and Procedures," U.S. EPA-330/9-78-001-R, June 1985.

"Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses," U.S. EPA, February 1988 (or most recent version).

"Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses," U.S. EPA, July 1988 (or most recent version).

"Specifications and Guidance for Obtaining Contaminant-Free Sample Containers," OSWER Directive #9240.0-05A, April 1992.

APPENDIX A

Ohio Environmental Protection Agency
Division of Emergency and Remedial Response
Field Standard Operating Procedures

FIELD STANDARD OPERATING PROCEDURES

Division of Emergency and Remedial Response

OHIO ENVIRONMENTAL
PROTECTION AGENCY

September 1998

**DERR SAMPLING GUIDANCE
VOLUME IV**

FIELD STANDARD OPERATING PROCEDURES
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- 14.01 Self-Contained Breathing Apparatus (SCBA) Maintenance, Cleaning and Storage
- 14.02 SCBA Operation and Use
- 14.03 Air Purifying Respirator Operation and Use**

15. Field Screening

- 15.01 Portable Gas Chromatograph
- 15.02 Headspace Analysis for VOCs in Soil
- 15.03 ASP-1 Analog Smart Portable Radiation Meter
- 15.04 Eberline Instruments Alarming Pocket Dosimeter

16. Decontamination

- 16.01 Decontamination of Sampling Equipment

17. Geoprobe **

Appendix A Photovac Technical Bulletin #1: Compounds Detectable with the Photovac Microtip, Tip, and the 10S Series of Portable Gas Chromatographs

** Not included in this draft - incomplete.

Initial Site Entry

A. Application

This procedure is to be followed when entering a site for the first time.

B. Limitations

The Ohio EPA must have legal access to enter a property.

C. Safety

See Procedures.

Refer to the site specific Health and Safety Plan.

D. Equipment Composition

N/A

E. Checklist

Background Information

Personal Protection Equipment

O₂/CGI meter

Photoionizer (Hnu, OVA, MicroTip, etc.)

Radiation meter

pH paper/meter

Compound specific instruments (if needed)

Atmospheric Hazard Action Guides

F. Procedures

I. Obtain available information through district office, complaint, etc. The following information to the extent available shall be obtained prior to site work to determine if conditions immediately dangerous to life and health (IDLH) exist.

- a. location and approximate size of site
- b. description and duration of job task to be performed
- c. safety and health hazards expected
- d. site topography and pathways of hazardous substance dispersion
- e. emergency response capabilities of the area

This information shall be incorporated into the Site Safety Plan. If IDLH conditions exist, a standby team will be necessary for site entry.

II. On site, survey and monitor perimeter for access points. Site shall be evacuated if work requires Level A. Level A is required when:

- a. hazardous substance has been identified and requires highest level of skin, eye and respiratory protection.
 - b. substances with a high hazard to skin are known or expected to be present and skin contact is possible, or
 - c. operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.
- III. Enter in a minimum of Level B. A minimum of two employees shall be required for site entry.
- IV. Monitor during entry using:
- a. O₂/CGI meter
 - b. Photoionizer (Hnu, OVA, MicroTip, etc.)
 - c. Radiation meter
 - d. pH paper/meter
 - e. Compound specific instruments
- V. Entry team shall systematically search the site for potential hazards.
- VI. Use Atmospheric Hazard Action Guides to determine if evacuation is necessary.
- VII. If levels do not warrant evacuation, document readings and exit.
- VIII. Use Atmospheric Hazard Action Guides to determine level of protection necessary for re-entry for specific tasks as well as for identifying clean areas where a lesser level of protection is warranted.
- IX. Special Instructions:
- a. All drum and closed container sampling shall be conducted in Level B.
 - b. Air hazards shall be monitored continuously during sampling.

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Date: April 1, 1997

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Atmospheric Hazard Action Guides

<u>Monitoring Equipment</u>	<u>Hazard</u>	<u>Level</u>	<u>Action</u>
Combustible Gas Indicator (CGI)	Explosive	<10% LEL	Continue monitoring with caution.
		10%-25% LEL	Continue monitoring with caution.
		>25% LEL	Explosion hazard. Evacuate.
Oxygen Meter (O ₂)	O ₂ deficient atmosphere/O ₂ displaced by toxic vapors	<19.5%	Monitor wearing SCBA (Level B) Note: CGI readings not valid; <19.5% O ₂
Radiation Survey	Gamma Radiation	3-5 times gamma bkgd-	Consult a Health Physicist.
		<1 mR/hr	Continue instrument monitoring.
		>1 mR/hr	Evacuate.
Photoionization respiratory Detector or other organic vapor meter	Organic vapors Gases	Background-	Continue monitoring. No
		1 unit above bkgd	equipment needed (based on vapors only).
		1 unit above bkgd- 10 units above bkgd	Continue monitoring in Level C provided O ₂ level is adequate.
		>10 units above bkgd	SCBA (Level B) needed. Continue monitoring.
pH Meter/Paper	Corrosive	<2 or >12.5	Use appropriate safety clothing to prevent skin contact.
Compound Specific Guides, Instruments			Refer to Atmospheric Hazard i.e. NIOSH Pocket Guide, to determine PEL & IDLH levels and appropriate protection.

Confined Space Entry

A. Application

This FSOP is provided to assist the worker in the definitions and hazards associated with entering a confined space. However, this is only a guideline with information pertaining to entering a confined space. Consult Health & Safety personnel before performing a confined space entry for further information.

B. Limitations

Specialized permits, training, and equipment is necessary before attempting confined space entry.

C. Safety

Consult Health & Safety personnel before performing a confined space entry for further information. Refer to Site Specific Health & Safety Plan developed for confined space entry.

D. Equipment Composition

Respiratory Protection	Hearing Protection
Hand & Arm Protection	Protective Clothing
Foot Protection	Communication Equipment
Rescue Equipment	Proper Retrieval Systems

E. Checklist

Air Monitoring Equipment	Log Book
Mobile Phone	Proper Permit

F. Procedures

I. Definitions:

- a. Confined space - a space or work area not designed or intended for normal human occupancy, having limited means of egress and poor natural ventilation, and/or any structure, including buildings which have limited means of egress.
- b. Permit-required confined space - means an enclosed space which:
 1. is large enough, and so confined, that an employee can bodily enter and perform assigned work;

2. has limited or restricted means for entry and exit, i.e. tankers, vessels, silos, storage bins, hoppers, vaults, pits and diked areas;
 3. is not designed for continuous employee occupancy;
 4. has one or more of the following characteristics:
 - a. contains or has a known potential to contain a hazardous atmosphere;
 - b. contains a material with the potential for engulfment of an entrant;
 - c. has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls, or a floor which slopes downward and tapers to a smaller cross-section;
 - d. contains any other recognized serious safety or health hazard.
- c. Confined Space Entry Permit (CSEP) - a document initiated by those to enter a permit required confined space. CSEP will be completed and approved by the Site Safety Officer before personnel will be permitted to enter the required confined space.
- d. Confined space observer - individual assigned to monitor activities of personnel working within a confined space. The observer summons rescue personnel in the event of an emergency and assists the rescue team.
- II. Pre-site entry:
- a. Evaluate the job to be done and identify the potential hazards before the job in a confined space is scheduled.
 - b. Ensure that all process piping, mechanical and electrical equipment, etc. has been disconnected, purged, blanked-off or locked and tagged as necessary.
 - c. If possible, ensure removal of any standing fluids that may produce toxic or displacing gases, vapors or dust.
 - d. If the confined space is determined to be a permit-required confined space, initiate a Confined Space Entry Permit (CSEP). See attached.
 - e. Ensure that the space is ventilated before starting work in the

confined space and for the duration of the time work is to be performed.

- f. Employees entering the confined space and the employee designated as the confined space observer shall be familiar with the contents of this SOP.
- g. Remote atmospheric testing of the confined space shall be conducted prior to entry. Monitoring shall be conducted to ensure:
 - 1. Oxygen content is between 19.5-23.0%
 - 2. No combustible gases are in the space.
 - 3. Absence of atmospheric contaminants.

If remote sensing is not possible, or above conditions are not met, Level B PPE is required.

III. Confined Space Attendant:

- a. While personnel are inside the confined space, a confined space attendant will monitor the activities and provide external assistance to those in the space.
- b. The attendant shall be provided the same PPE as those working in the confined space.
- c. The confined space attendant shall maintain at least voice contact with all personnel in the confined space. Visual contact is preferred, if possible.
- d. The attendant shall be instructed in the method for contacting rescue personnel in the event of an emergency.
- e. The attendant shall order entrants to evacuate the space immediately when:
 - i) the attendant observes a condition which is not permitted in the space;
 - ii) the attendant detects behavioral effects of hazard exposure;
 - iii) the attendant detects a situation outside the space which could endanger entrants;
 - iv) the attendant detects an uncontrolled hazard within the space;

- v) the attendant must leave the work station.
 - f. In the event of an emergency, the attendant must NEVER enter the confined space prior to contacting and receiving assistance from a helper.
- IV. Entry:
- a. A permit-required confined space may not be entered until the CSEP has been approved.
 - b. Confined spaces shall be monitored as indicated in Initial Site Entry FSOP: 1.01. Level of protection may be downgraded as indicated in FSOP: 1.01.
 - c. Only explosion-proof and spark-proof equipment shall be used in permit-required confined spaces.
- V. Rescue Provisions:
- a. A ladder is required in all confined spaces deeper than the employee's shoulders.
 - b. In a permit-required confined space which requires respiratory equipment or in which rescue may be difficult, safety belts, harnesses and lifeline shall be used.

Site Entry with Potential Radiation

FSOP: 1.03

Date: April 1, 1997

Revision #: _____

Approved by: _____

Page 1 of 2

A. Application

As field staff investigates closed or abandoned sites, elevated levels of radioactivity may be encountered. Some of these areas will be known radiological sites and others will be absolutely uncharacterized. This procedure should help staff determine whether a radiological hazard exists and appropriate notifications and protective actions if contamination is found.

B. Limitations

N/A

C. Safety

Refer to Site Specific Health & Safety Plan

D. Equipment Composition

N/A

E. Checklist

Log Book

F. Procedures

1. For general background surveying a gamma detection instrument is most appropriate. Gamma is the most penetrating and the most common radiation, being a secondary emission for most Beta and Alpha decays. The background radiation measured will vary with the instrument and probe (detector) combination used for the survey. Integrated instruments such as a digital alarming dosimeter or a rate meter will often have internal corrections calibrated to a specified energy. These will give a relatively accurate reading on the actual exposure compared to that energy. It is still important to calibrate any rate meter or other survey instrument to a check source.
2. Establish the background for an area by taking readings at several locations about a block away from the site and averaging them. Compare a site background from the parking or access area to see if it is significantly different. Building materials can affect the local background readings, particularly brick or stone materials that may contain Uranium or Thorium and any decay daughters. These can cause a detectable increase in background.

These area and site background reading should be included in your field notes.

3. **Note** Please use micro instead of m and milli instead of m as a prefix. There have been several false alarms requiring the dispatch of a radiological survey team because of mix ups in transcriptions or misuse of the single character abbreviations.

ACTION LEVELS:

4. "Normal background exposure rate for gamma radiation is approximately 0.01 to 0.02 milliR/hr (10 to 20 microR/hr). Work may continue with elevated radiation exposure rates. However, if the exposure rate increases to 3 to 5 times above the gamma background, a qualified health physicist should be consulted." USEPA Standard Operating Safety Guide.
5. If readings of 3 to 5 times background gamma are encountered work does not need to stop, but a note needs to be made to contact a health physicist on return to the office. The Memorandum of Understanding between OEPA and ODH designates ODH as the supplier of health physicists for field surveys. The number of the ODH Radiological Safety Bureau is 614-644-2727. Ask for the Radioactive Materials Unit.
6. The turn back exposure rate for Ohio EPA employees is 1.0 milliR/hr. If normal background is 0.01 to 0.02 milliR/hr the turn back value is 50 to 100 times greater. If an OEPA field team encounters a radiation exposure rate of 1.0 milliR/hr they should stop work at that location and immediately contact a qualified health physicist. The Memorandum of Understanding between OEPA and ODH designates ODH as the supplier of health physicists for field surveys. The number of the ODH Radiological Safety Bureau is 614-644-2727. Ask for the Radioactive Materials Unit.

Logbook

A. Application

The logbook is utilized as the source for site-related/project specific information, especially data, and any related site/project activity. The information should be clear and understandable with enough detail that another individual(s) can comprehend the events of the site-related/sampling activity.

B. Limitations

Adequate detail for each entry into a logbook is essential. Loose-leaf and/or tear-out pages are unacceptable.

C. Safety

N/A

D. Equipment Composition

Logbooks should be bound and paginated. Pages within the logbook should be consecutively numbered with a preprinted page number. Non-erasable, waterproof ink should be used - except when weather conditions do not permit the use of such writing implements.

E. Checklist

Logbook
Permanent marker/pen

F. Procedures

Entries must include the signature(s)/initials of all persons making entries and the date of the entry. This should be located at the end of each page and/or entry. Corrections should be made by single line through the information and then initialed and dated by the person making the correction and/or entering the material.

For each site, the following entries should be included;

1. Equipment/instrument calibration
 - Instrument name and model
 - Serial number/instrument number
 - Date and time of calibration
 - Signature(s) of person calibrating instrument
 - Battery check (when applicable)
 - Standards utilized
 - Instrument reading including units for measurement

2. Field measurements
 - Type of measurement
 - Reading
 - Units
3. Sample type
 - Grab
 - Replicate/Duplicate
 - Composite
 - Trip blank
 - Biased
 - Etc.
4. Description of sampling method and activity
 - Indication that activity was done according to FSOP
 - Sample depth(s)
 - Sketch of sample location
 - Observations - including weather conditions
 - Calculations/equations
 - Sample time (should match sample label)
 - Personnel conducting activity/sampling
5. Deviations from Sampling Plan
6. Photographic log (photo number)
7. Sample Numbers, types of analysis
8. Names of individuals - other than crew - who were present
(i.e. USEPA personnel, facility representatives, other Agency personnel)

Garmin Global Positioning System (GPS)

A. Application

The Garmin Global Positioning System (GPS) is a satellite tracking device which enables you to obtain a rough estimate of latitude and longitude as it pertains to your current location.

B. Limitations

The GPS 75 is limited by accuracy. A minimum accuracy of approximately 595 feet and a maximum accuracy of 49 feet is achievable with the unit depending on number of satellites tracked, signal strength, and topography.

C. Safety

The GPS 75 is not intrinsically safe. Follow manufacturer's recommendation for safe use of this product and refer to site-specific Health and Safety Plan.

D. Equipment Composition

Garmin GPS 75 unit.

E. Checklist

GPS 75 Unit
Log book

F. Procedures

To obtain Geographical Coordinates:

1. Press Pwr/Stat key to turn unit on.
2. Raise antenna to a vertical orientation.
3. Place GPS unit on a vehicle or on a protective cloth on the ground and stand back while the unit acquires satellites. Bar representing acquired satellites will appear on the screen. Signal strength is proportional to bar height. Once the GPS acquires enough satellites (usually 4) the screen will automatically display the geographic coordinates. No calibration or maintenance is required for the unit.
4. For an estimate of position error, press the Pwr/Stat switch once and note the Estimated Position Error (EPE). This should be noted in the log book. (Leaving the GPS to track satellites for a longer period of time does not necessarily mean that you will get

a more accurate reading.

To return to the coordinate display screen, press Nav.

5. To turn the unit off, press and hold the Pwr/Stat switch for 3 seconds.

Storing Waypoints: A waypoint is a geographical coordinate that is entered into the GPS. It becomes an established, computer logged position that can be navigated to or from.

1. Obtain a lock on geographical coordinates as described above in item 3.
2. Press the Auto Sto button.
3. The unit will automatically assign a numerical name to the waypoint. This number can be changed to a user assigned name by using the arrow keys to highlight the waypoint name. Change each character by toggling one key at a time using the arrow keys. For example: Press the "2" key to select either a 2, D, E, or F character using the arrow keys.

Navigating to a Waypoint:

* There are a few ways to navigate to a particular waypoint but this is the least complicated method.

1. Press the Goto/Mob button.
2. When the "Go To" field appears, press WPT (waypoint) to retrieve your first waypoint. You may then use the arrow keys to toggle through the stored waypoints. You may also type the waypoint name in as mentioned above.
3. Once your waypoint is displayed on the screen press enter. A navigation summary page will appear which displays BRG(bearing), TRK (track), RNG (range to destination) and GS(ground speed). BRG is the direction from your position to the "active" waypoint. TRK is the direction of your movement.
4. Start by walking a short distance while monitoring your TRK bearing. Adjust your direction of travel so that the TRK bearing matches or comes close to the direction to destination (BRG) bearing. Proceed toward your destination making course corrections along the way. RNG will decrease as you approach your destination.
5. As you approach your destination an "MSG" signal indicating a message will appear in the lower left corner of the screen. To view it, toggle the pwr/stat button. It should say "approaching destination."

Photograph Documentation

FSOP: 2.03
Date April 11, 1997
Revision #: _____
Approved By: _____
Page 1 of 2

A. Application

When photographing a field sampling events there should be a minimum of two to three photos taken at each individual sampling matrix. After every sampling event there should be a minimum of three prints developed. The first set of prints going to US. EPA, the second set of prints going to the appropriate District and district files, and the third set of prints stays in the SIFU file.

B. Limitations

Do not include any person collecting the samples in any exposure print.

Do not take any exposure prints in direct path of sun.

Always keep fingers away from lens before taking photo.

It is preferred to used 12 Exposure film over 24 Exposure film, due to over lapping Field sites. This assures film developing in a timely manor.

C. Safety

N\A

D. Equipment Composition

N\A

E. Checklist

Batteries

Camera

Film

Picture identification clipboard

Logbook

D. Procedures

1. The first exposure print should be of the empty labeled sample containers. The labeling must include a sample ID name and number, date, and time.
2. The second exposure print is a site specific sample matrix collected including sample stakes and/or flag and sample ID clipboard.

Information on the identification (ID) clipboard should always include:

- 1). Site Name
 - 2). Sample ID number
 - 3). Time
 - 4). Date
 - 5). Sample location
3. The third exposure print should display the collected sample, site specific sample stakes or flag, the sample ID clipboard, and any key area land benchmarks; that will better enable the coordinators to relocate themselves back to that specific sampling location.

Chain of Custody

- A. Application
Completion of various chain of custody forms. The following examples for both federal organic and inorganic chain of custody forms are similar to the contents that would be entered on any chain of custody form. Refer to the laboratory specific chain of custody if sending samples to a "state contract" laboratory.
- B. Limitations
n/a
- C. Safety
n/a
- D. Equipment Composition
n/a
- E. Checklist
Chain of Custody form
Pen
- F. Procedures for Federal Traffic Report & Chain of Custody Record
The following explanations correspond to the numbers on the attached COC example as to what needs to be entered in each space.
1. **Project Code:** Leave blank.
 2. **Account Code:** Leave blank.
 3. **Region No.:** USEPA Region V (5)
 4. **Sampling Co.:** Ohio EPA
 5. **Date Shipped:** Date
 6. **Carrier:** Examples: Airborne, Federal Express, UPS.
 7. **SAS No.:** Not applicable
 8. **Case No.:** No. Supplied by Region 5
 9. **Regional Info.:** TFA-102
 10. **Sampler Name:** Sampler name on tag (SIFU project coordinator).
 11. **Airbill No.:** Number provided on carriers airbills for cooler.
 12. **Non-Superfund Program:** Leave blank

13. **Sampler Signature:** Same as # 10.
14. **Ship to:** Address of Lab receiving samples. Attn: sample custodian. Include phone number of lab.
15. **Site Name:** Site name as appears on CERCLIS.
16. **City, State:** City, State site is located.
17. **Site Spill ID:** If no previous action or number was given..assume "ZZ."
18. **Purpose:** Check boxes as associated with the site.
19. **CLP Sample #:** Inorganic/organic sample number. Ex. METC0 for inorganic or EASE0 for organic.
20. **Matrix:** Type (media)of sample collected.
21. **Concentration:** Low (L), Medium (M) @ High (H). Low is assumed for RAS analysis.
22. **Sample Type:** Composite © or Grab (G)sample collected in Field.
23. **Preservative:** Type of preservative if used for preserving sample.
24. **RAS Analysis:** Check analysis requested.
25. **Regional Specific Tracking or Tag Numbers:**
Tags that are used to identify a specific sample.
26. **Station Location Identifier:**
Location description as appears on tag (keep short).
27. **Mo/Day/Year/time Sample collection:**
Month/Day/Year and time sample was collected.
28. **Corresponding CLP Inorganic or Organic Sample Number:**
Sample number used on either inorganic or organic form.
29. **Sample Initial:** Line out and initial column.

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30. **Field QC Qualifier:**
Mainly used for Duplicate sample qualifier,
i.e. D=METC0.
31. **Shipment for Case Complete? (Y/N):**
Circle yes if the cooler contains all of the
samples being sent to the lab. If multiple
coolers are being used, circle no on all of
the COC's except for the last cooler (i.e.
cooler 8/8) in which you would circle yes.
32. **Page:**
Pages of COC used if more than one cooler.
33. **Sample(s) to be used for Lab QC:**
MS/MSD (Matrix Spike/Matrix Spike
Duplicate) Sample number (i.e. MS/MSD=METC0).
34. **Additional Sampler Signatures:**
Leave blank.
35. **Chain of Custody Seal numbers:**
USEPA Custody Seals used to seal coolers
(2).
36. **Relinquished by:**
Same signature as appears in box 13.
37. **Date/Time:**
Date/time cooler was relinquished to
shipper.

Sample Collection
Technique for Surface
Water Sampling

FSOP: 4.01
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

A. Application

This bottle filling technique is used when sampling surface water with any sample collection device or procedure. Start sampling downstream and work your way upstream collecting the samples.

B. Limitations

Splashing and aeration of the water during bottle filling may cause loss of volatile organic compounds.

Disturbance of water sediments may have an effect on the surface water sample integrity.

C. Safety

Use caution when handling glass bottles and preservatives.

D. Equipment Composition

Sampling equipment may be used. Bottles are filled directly from the sampling device.

E. Checklist

Bottles	Sample tags and/or labels
Gloves	Paper Towels
Cooler and ice	Water Proof Marker
Preservatives, i.e. HCl, HNO ₃ , NaOH	

E. Procedures

1. Complete the bottle label before filling with water. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOCs, Semi-VOCs, PCB/Pesticides, Metals. Don sampling gloves and appropriate protective equipment. Preserve the sample vials with the appropriate preservative for that specific sample analysis. (The sample bottles can be pre-preserved prior to the sampling event or after sample collection.)
2. Submerge the sample vial for volatile organic analysis (VOA) below the water surface. Hold the vial upside down while submerging. Minimize of the waters surface. While the vial is submerged, slowly turn the vials upright allowing the vial to fill and reach equilibrium. Fill the vial far enough below the water surface so that the surface film on the water is not incorporated into the sample. This surface film may contain organic matter. If the surface water is flowing, position the sample bottle opening upstream.
3. Hold bottles for other analyses upside down. While the vial is submerged, slowly turn the vials upright allowing it to fill to

the desired volume (to the shoulder for most bottles). Fill the bottle far enough below the water surface so that the surface film on the water is not collected in the sample. Collect the sample with the sample bottle upstream.

4. Place the cap on the VOA vial while submerged. Check the teflon coated septum's orientation, make sure the teflon side is on the sample side. Bottles for other analyses do not have to be capped while submerged. Invert the VOA vial and gently tap to verify that there are no air bubbles entrapped in the sample vial. If air bubbles are present, resample using a new VOA vial. For proper sample bottle type, number of containers, and preservatives required for analytical results consult either the district lab coordinator or the laboratory analyzing the samples collected.
5. Clean the outside of the bottle with deionized water and/or a paper towel. Attach sample tags when needed.
6. Preserve the sample on ice as soon as possible after filling, cooling to 4°C. Some samples for organic analysis need to be protected from light by using amber bottles and/or by placing in a cooler. Since lids tend to loosen after containers are cooled, retighten after having been on ice for about 30 minutes.
7. Make sure all applicable sections in the log book are filled out properly. If possible, Chain-of-Custody forms must be completed by the samplers before leaving site. Ship the samples as soon as possible to minimize sample holding time.
8. For documentation purposes, photograph the area with the sample containers next to sample location.

Surface Water Sampling
by Bottle Immersion

A. Application

Method utilized for the collection of aqueous samples.

Can immerse by hand or by extension rods with bottle attachment.

Fast and simple (no equipment decontamination or rinsates needed).

B. Limitations & Safety

Immersing by hand is not acceptable where high contamination is a possibility.

Outside surface of bottle must be cleaned after sampling.

The teflon cap liner or septum liner in the cap may fall or float out of cap. The loss of the teflon liner may result in compromising the sample integrity. Thus the sample bottle should be discarded and a new sample container should be utilized.

C. Equipment Composition

Standard sampling bottles will be used for required parameter analyses. (Consult either your district lab coordinator or laboratory contact for sample bottle types needed for analysis.)

D. Checklist

Extension Rod	Gloves
Decontamination supplies	Cooler and ice
Water Proof Marker	Sample Labels
Log Book	Sample Bottles

E. Procedures

1. Complete the label on the bottle or vial before submerging.
2. Submerge the sample vial with lid removed below the water surface. Minimize disturbance of the water surface. Fill the vial far enough below the water surface so that any film on the water is not incorporated into the sample. (This surface film may contain a substantial amount of organic matter which may or may not be volatile organics.) If the body of water has flow, position the open end of the bottle into the flow (upstream). Place the sample bottle lid tightly on after removing from the water body.

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3. Clean the outside of the bottle with deionized water and/or a paper towel. Attach sample tags when needed. Retighten the sample bottle lid to assure a secure seal on the sample bottle.
4. Collect and Handle samples following the procedures outlined in **FSOP 4.01, Sample Collection Technique for Surface Water Sampling.**

Surface Water Sampling
by Kemmerer Bottle

A. Application

This sample collection equipment allows you to collect an at depth discrete sample without further contact with the water column.

For the collection of samples in vessels (wells) at depths that may exceed the lift capacity of pumps.

B. Limitations

Vertical orientation may cause problems in fast flowing or shallow water.

C. Safety

Refer to site-specific Health & Safety Plan

D. Equipment Composition

Most are made of stainless steel and polypropylene or plastic and polypropylene. The messenger is used to seal the kemmerer when the desired sample depth is reached.

E. Checklist

Kemmerer	Decontamination supplies
Messenger	Cooler and ice
Rope	Log Book

F. Procedures

1. Attach one end of the Kemmerer.
2. Secure other end of the rope to boat or stationary object.
3. Check the attachment of the kemmerer bottle to the rope and the rope to the stationary object.
4. Mark the rope for the desired sampling depth(s).
5. Attach the messenger to the rope and set the trip mechanism on the dredge being careful not to place fingers and hands into any pinch points.
6. Lower the kemmerer to the desired sampling depth. With the rope taut drop or slide the messenger towards the kemmerer.
7. Bring the kemmerer to the surface. Hold the kemmerer by the lower stopper, center rod, or by the rope.
8. Fill the sample bottles using the using the drain valve on the lower stopper. You may want to slightly open the upper stopper as you are filling sample bottles as sometimes a vacuum is built up as the kemmerer is emptied. Fill the VOA vials first with a gentle

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stream of collected sample (do not aerate the sample) until there is an inverted meniscus (convex).

7. Clean the outside of the bottle with deionized water and/or a paper towel. Attach sample tags when needed.
8. Collect and Handle samples following the procedures outlined in **FSOP 4.01, Sample Collection Technique for Surface Water Sampling.**

**Surface Water Sampling
by Dipper**

A. Application

Can be used for most surface water sampling. Fast and simple. Can be extended on rods to reach otherwise inaccessible areas.

B. Limitations

This is not the preferred method when sampling for volatile organic analysis (VOA) due to potential aeration of the sample.

This method is not recommended when significant material may be lost due to adhesion on the dipper.

C. Safety

High currents may jerk or pull on the dipper.

Horizontal extension of a full dipper is sometimes difficult and requires good balance.

D. Equipment Composition

Stainless steel preferred

Most made of polyethylene and are not recommended for sampling organic analysis.

E. Checklist

Dipper and extension rod(s)
Decontamination supplies
Cooler and ice
Log Book

F. Procedures

1. Gently submerge the stainless steel (SS) dipper below the water surface, minimizing disturbance.
2. Allow the dipper to slowly fill. It is preferable to completely submerge the dipper.
3. Gently raise the dipper taking care not to agitate the sample.
4. Tilt the bottle or vial and fill from the dipper as if filling a glass with a carbonated beverage while trying to not form foam. Try not to touch the bottle to the dipper.
5. Clean the outside of the bottle with water and/or a paper towel. Attach sample tags when needed.
6. Collect and Handle samples following the procedures outlined in FSOP 4.01, Sample Collection Technique for Surface Water Sampling.

Sample Collection Technique
for Groundwater Sampling

A. Application

This sample collection technique is used when sampling groundwater with any sample collection device.

Bottles are filled directly from the sampling device or spigot.

B. Limitations

Splashing and aeration of the water during bottle filling may cause loss of volatile organic compounds.

C. Safety

Use caution when handling glass bottles and preservatives.

See Site Health and Safety Plan for other, possible safety considerations.

D. Equipment Composition

Sampling devices will vary, and are specifically listed elsewhere in this manual.

Preferred sample container: Glass jar with a Teflon® lined lid. Glass may be clear, but should be amber for photo sensitive chemical compounds.

E. Checklist

Bottles
Sample tags and/or labels
Preservatives, i.e. HCl, HNO₃, NaOH
Gloves (Vinyl and Nitrile)
Kimwipe Towels
Cooler and ice
Logbook

F. Procedures

1. Complete the bottle label before filling with water. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOCs, Semi-VOCs, PCB/Pesticides, Metals.
2. Tilt the bottle and fill from the valve or faucet trying not to create foam or aerate the sample. Try not to touch the bottle to

the faucet. Vials for volatile organic analyses (VOA) samples should be filled until there is an inverted meniscus (convex) over the lip of the bottle.

Place the septum cap on the vial at an angle over the meniscus, straighten cap, then tighten onto vial. Invert the vial and gently tap to verify that there are no bubbles trapped in the sample. If air bubbles are present, resample using a new VOA vial. Fill other bottles to the desired volume (to the shoulder for most bottles to allow for expansion).

3. Preserve the sample as soon as possible after filling. Samples to be analyzed for VOCs should be preserved with HCl, metals should be preserved with HNO₃ and cyanide should be preserved with NaOH. All samples should be placed in ice and cooled to 4°C. Fifteen minutes after placing on ice, check and retighten caps on VOA vials to prevent the infiltration of air and contaminants.
4. Clean the outside of the bottle with water and/or a clean towel. Attach sample tags and place in sealable plastic bags as necessary.
5. Make sure all applicable sections in the log book are filled out properly. For documentation purposes, photograph the area with the sample containers next to sample location.
6. If possible, Chain-Of-Custody forms should be completed by the samplers before leaving the site.
7. Samples must be packaged and shipped according to Department of Transportation regulations when applicable. At a minimum, samples must be packaged to prevent breakage, and should be shipped as soon as possible to minimize sample holding time.

Obtaining Water Level Measurements
in Groundwater Wells

FSOP: 5.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

A. Application

The most accurate measuring device is the electronic tape; it is also simplest to use and easiest to decontaminate.

Chalked tape is accurate but unacceptable, because the chalk or paste will contaminate the water sample.

When purging a well, floating and/or sinking immiscible layers should be identified when the water level is taken.

If water level measurements are to be used for hydrogeological purposes, measure all wells within 24 hours to the nearest 0.01 foot before purging any wells.

B. Limitations

In some instances, water levels in nearby wells can be drawn down from well purging or sampling.

The measuring device must be decontaminated after each use.

Depth to water can change measurably with changes in barometric pressure. The same measuring device and field team should measure all wells.

C. Safety

Equipment should be monitored as it is raised out of the well with air monitoring instruments normally used at hazardous material sites, i.e. radiation and organic vapor meters and explosimeter.

D. Equipment Composition

Teflon equipment is preferred; although, most water level meters are made of plastic and/or metal (lead weights).

E. Checklist

Water-level Indicator
Monitoring Instruments
Decontamination Supplies
Logbook

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F. Procedures

1. After monitoring the air for hazardous constituents, open the well and continue monitoring.
2. Lower the probe of the water level meter into the well until the water level is reached (indicated by a light, beep, pop or deflection of the needle). Measure water level from the top of the inner well casing to the nearest 0.1 to 0.01 foot (1/8 inch). This reference point should be professionally surveyed for accurate water level determination.
3. If the depth of the well is not known, and if the well volume needs to be calculated, lower the probe to the bottom of the well. Measure and record the depth of the well against the top of the casing.

Well Volume Calculation

Well sampling should be preceded by purging the well of a specified amount of water, usually three to five well volumes. Information needed to calculate one well volume includes depth to water, depth of well and diameter of well. Depth measurements should be taken from the top of the inner casing, and all units should be in feet, measured to hundredths of an inch. One well volume is calculated as follows:

One well volume = water column in feet X gallons/feet for
to 100ths of an inch inside diameter
of well in inches

$$\text{One well volume (gallons)} = \pi \frac{D^2}{4} \times (h_d - h_w) \times (7.48)$$

$$\pi = 3.14$$

D = diameter of well in feet

$$h_d = \text{depth of well in feet}$$

h_w = depth to water in feet

7.48 (gal/feet) = conversion factor from cubic feet to gallons

The conversion factors below can be used for a quick verification of the above calculations.

<u>Inside Diameter of Well (inches)</u>	<u>Gallons/Feet</u>
1.0	0.041
1.5	0.092
2.0	0.163
3.0	0.367
4.0	0.653
6.0	1.470

Well Purging

A. Application

The objective of purging a well is to obtain a representative groundwater sample by removing all stagnant water from the well. Groundwater that remains in a well casing for an extended period of time (i.e. more than about two hours) has had the opportunity to exchange gases with the atmosphere and to interact with the well casing material. The chemistry of the groundwater stored in the well casing is unrepresentative of the water in the aquifer.

B. Limitations

Purge water must be contained and preferably segregated from one well to another if there is a possibility that the water is contaminated.

Low producing wells can make it difficult to purge timely and consistently.

C. Safety

Avoid splashing or creating aerosols (atomization).

D. Equipment Composition

A peristaltic pump may be used for purging, but is limited to a depth of about 25 feet. It is not acceptable for collecting volatile organic samples due to the possibility of gas stripping.

Submersible pumps are difficult to decontaminate. They often contain plastic, rubber, or metal parts that may not be compatible with the parameters to be analyzed.

Bailers are constructed of a variety of materials. It may be very time consuming to purge a well with a bailer depending on the volume of water in the well.

The bladder pump (positive displacement) is the preferred method for purging and sampling groundwater.

E. Checklist

Water-level indicator
Air monitoring instruments

Decontamination supplies
Pump or bailer
Container for purge water, i.e. drum
Water monitoring instruments:
 pH meter
 specific conductivity meter
 thermometer
 dissolved oxygen meter
Calculator
Logbook

F. Procedures

1. Measure the water level and calculate the volume of water (See FSOP: 5.03) in the well; determine the appropriate volume to purge (3-5 well volumes).
2. Measure and record water quality parameters such as pH, specific conductivity, temperature and dissolved oxygen.
3. Pump or bail the groundwater into a graduated bucket, transferring into larger container as needed.
4. Measure and record the water quality parameters and volume of water purged after each well volume. If measured parameters have stabilized within + or - 10%, the well has been completely purged. If measured parameters are not within + or - 10% after purging three well volumes, continue purging until they are stabilized over two successive well volumes.
5. Upon completion of purging the well, the groundwater may be sampled using a pump or bailer (see FSOPs 5.06-5.09 for various types of well sampling methods).

I. Considerations

1. Wells should be sampled immediately following purging. If the well is purged to dryness, it should be sampled as soon as sufficient water is available.
2. Purging the well at a rate faster than it can recover may cause water to cascade down the well screen, which may cause a loss of volatile organic compounds and/or oxidation of the sample.
3. If purge water is found to contain hazardous waste, it must be disposed of at a permitted facility; therefore, the volume of water to be purged from the well should be minimized.

Filtering of Groundwater Samples**A. Application**

Field filtration can be used to remove the immobile sediment fraction that may contribute to the turbidity of a sample. Turbidity is an important field concern for samples to be analyzed for metals (e.g. cadmium, nickel, zinc) or metalloids (e.g. arsenic, selenium).

There are two types of filtration that can be used in the field: In-Line Filtration (Closed System) in which a sampling pump provides positive pressure to force the sample through an attached filter into a sample bottle, and Pressure Filtration (Open System) in which the sample is either pulled through the filter by vacuum or is driven through the filter by an inert pressurized gas or a peristaltic-type pump. Pressure Filtration requires the sample to be transferred from the sampling device to the filtering apparatus, exposing the sample to the atmosphere.

B. Limitations**Non-Filtered Groundwater Sampling Method**

If immobile particles to which metals are bound are present in the preserved (acidified) sample, the true concentration of mobile species will be overestimated in laboratory analyses. The acidic preservative dissolves precipitates or causes adsorbed metals to desorb from immobile particles. This desorption is not representative of what may be occurring in the groundwater.

Filtered Groundwater Sampling Method

Groundwater sample filtration can potentially remove particles that may be mobile in certain hydrogeologic environments. If these mobile particles to which metals may be bound are removed from the sample, the altered sample becomes unrepresentative of the groundwater.

Sampling technique, sampling device, filter clogging, variable particle size retention, filter media leaching and aeration are potential problems that occur when filtering groundwater samples. Proper well installation, well development and sampling technique can greatly reduce sample turbidity, and eliminate the need for field filtration.

C. Safety

Avoid splashing or creating aerosols (atomization).

When using the Pressure Filtration method, handle high pressure nitrogen

gas cylinders with caution. Nitrogen gas pockets can form creating a flammable atmosphere.

D. Equipment Composition

Filters must be inert; nitrocellulose filters may contaminate the sample with N, P, Zn and Mo. Polycarbonate membrane, cellulose acetate and glass microfiber filters are available.

Filter devices are made of non-metal materials such as plastic, acrylic or teflon.

E. Checklist

Filter apparatus
Filter paper (0.45 micron pore size)
Pump (In-Line Filtration)
Nitrogen tank and regulator (Pressure Filtration)
pH paper
Deionized or distilled water
Disposable pipets
Nitric acid preservative

F. Procedures

In-Line Filtration Method

1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).
2. Measure and record water quality parameters.
3. Set up the filtering apparatus using a 0.45 um filter and a pre-filter.
4. Pump groundwater from the well, discarding the first 100-150 ml.
5. Continue pumping water directly through the filter into the sample bottle. Preserve the sample after it has been filtered.
6. Collect and handle samples following the procedures outlined in FSOP: 3.01.

Pressure Filtration Method

1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).

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2. Measure and record water quality parameters.
3. Extract the groundwater sample from the well with a bailer or pump. Discard the first 100-150 ml.
4. Place the sample into the sample reservoir of the filtering apparatus as soon as possible after collection.
5. Assemble the filtering apparatus to use a vacuum or pressurized system to drive the sample through the filter into the sample bottle.
6. For pressure filtration, connect nitrogen supply to the filtering apparatus. Set the regulator to the appropriate psig. **[what is appropriate?]** Slowly open the valve, and check for leaks.
7. Collect and handle samples following the procedures outlined in FSOP: 3.01.

Bailer Sampling

A. Application

Hand bailers are portable groundwater sampling devices which do not require a power source. There are conventional and dual check valve bailers, and some have stopcock spigots. Bailers can be constructed of a variety of materials (PVC, teflon, stainless steel), and come in many sizes (lengths and diameters).

B. Limitations

Because hand bailing is time consuming, this method of groundwater sampling may not be suitable for purging large volume wells.

Filling sample bottles from a bailer takes a steady hand.

Off-gassing of volatile organics must be minimized by reducing sample aeration.

C. Safety

Avoid splashing or creating aerosols (atomization).

D. Equipment Composition

Bailers are made of PVC (suitable for metal analyses only), stainless steel (suitable for organic analyses only) and teflon (suitable for organic or metal analyses). The construction of the bailer must be compatible to the ease of decontamination. Rounded threads and ease of disassembly are important factors to consider for decontamination.

E. Checklist

Bailer
Stainless steel, polypropylene or teflon-coated wire or rope
Water level indicator
Water quality instruments
Graduated bucket
Sample bottles
Personnel protective clothing (gloves, boot covers)
Cooler and ice
Barrel(s) for purge water
Logbook

F. Procedures

1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).
2. Measure and record water quality parameters.
3. Attach bailer rope or cable to the bailer. Do not allow rope to touch the ground. Suspend the rope with your arms, or collect it in a bucket or on a piece of plastic sheeting.
4. Slowly lower the bailer down the well to the water level. Do not allow the bailer to free-fall into the water or touch the bottom of the well.
5. Lower the bailer to the same depth in the well each time, preferably within or just above the screened interval.
6. Allow the bailer to sink with a minimum of surface disturbance.
7. Raise the bailer slowly. Try not to allow the bailer rope to touch the sides of the well.
8. Whether water is discharged from a hole in the top of the bailer or from a spigot in the bottom of the bailer, slowly tip the bailer to pour water into the sample bottle with a minimum of disturbance.
9. Collect and handle samples following the procedures outlined in FSOP: 3.01.
10. Decon between each unique sample location, unless a clean, dedicated bailer is being used at each sample location.

Bladder Pump Sampling

A. Application

Bladder pump sampling is an efficient and simple method to collect representative groundwater samples.

The bladder pump should be operated in a continuous manner, so that it does not produce pulsating surges that aerate the water in the return tube or upon discharge. This method causes minimum disturbance of the sample-driving gas, and does not allow the sampler to contact the sample.

This pump can be used to depths of up to 400 feet, and can be dedicated to a well or portable. The pump should purge at 500 ml/min, and decreased to 100 ml/min during sample collection.

B. Limitations

Difficult to decontaminate

Long cycles needed for deep wells

C. Safety

Avoid splashing or creating aerosols (atomization).

D. Equipment Composition

Most bladder pumps are made of all teflon or teflon and stainless steel. Bladder and tubing material should be carefully selected.

E. Checklist

Bladder pump w/ tubing
Air pump
Compressed air supply or electrical power source
Water level indicator
Graduated bucket
Sample bottles
Personnel protective clothing (gloves, boot covers)
Cooler and ice
Water quality instruments
Filtering apparatus
Barrel(s) for purge water
Bung wrench
Logbook

F. Procedures

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1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).
2. Measure and record water quality parameters
3. For non-dedicated bladder pumps, lower the pump to the middle of the well screen, and adjust the flow rate to deliver approximately 100 ml/min. The pump should operate continuously during sampling, so aeration in the return tube or upon discharge is minimized.
4. Collect and handle samples following the procedures outlined in FSOP: 3.01.
5. Decon between each unique sample location, unless a clean, dedicated bladder pump is used at each sample location.

Peristaltic Pump Sampling**A. Application**

This method of groundwater sampling is advantageous when the required sample volume exceeds several liters up to a depth of approximately 25 feet. The pump is portable and requires a power source. The tubing should be dedicated or it will need to be decontaminated for reuse.

B. Limitations

Sampling for volatile organic compounds (VOCs) is not recommended. Samples for VOCs should be collected with a bailer before any other samples are collected. The vacuum required to draw the water to the surface will strip the VOCs from the water sample.

The peristaltic pump cannot lift water in excess of approximately 25 feet.

This type of pump requires a power source, and is a relatively slow method of well purging.

C. Safety

Avoid splashing or creating aerosols (atomization).

D. Equipment Composition

A flexible tubing is used for the pump, whereas a more rigid tubing such as teflon is used for the sample. A tubing trap may be used to trap the sample in a bottle or a transfer flask.

E. Checklist

Peristaltic pump
Tubing
Power source
Water level indicator
Graduated bucket
Sample bottles
Personnel protective clothing (gloves, boot covers)
Cooler and ice
Water quality instruments
Filtering apparatus
Barrel(s) for purge water; bung wrench
Logbook

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F. Procedures

1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).
2. Measure and record water quality parameters.
3. Slowly lower the sample tubing to the middle of the well screen, and adjust the flow rate to deliver approximately 100 ml/min. The pump should operate continuously during sampling, so aeration in the return tube or upon discharge is minimized.
4. Collect and handle samples following the procedures outlined in FSOP: 3.01.
5. Decon between each unique sample location, unless clean, dedicated equipment is used at each sample location.

Submersible Pump Sampling

A. Application

This pumping method is very suitable for purging a large volume of groundwater from up to 200-300 foot depths, depending on the length of hose used. Because of water agitation caused by purge rate, depth and volume, this pumping method is not recommended for sampling; although the pump rate can be set as low as 100 ml/min.

B. Limitations

This type of pump requires a power source, and is cumbersome to decontaminate.

C. Safety

Avoid splashing or creating aerosols (atomization).

Necessary precautions should be taken when working around electricity and water.

D. Equipment Composition

Submersible pumps contain plastic, rubber and/or metal parts.

E. Checklist

Submersible pump
Tubing
Power source
Water level indicator
Graduated bucket
Sample bottles
Personnel protective clothing (gloves, boot covers)
Cooler and ice
Water quality instruments
Barrel(s) for purge water
Bung Wrench

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F. Procedures

1. Calculate well volume, and determine purge volume (see FSOP: 3.03 Well Volume Calculation).
2. Measure and record water quality parameters.
3. Slowly lower the pump head to the middle of the well screen, and adjust the flow rate to deliver approximately 100 ml/min. The pump should operate continuously during sampling, so aeration in the return tube or upon discharge is minimized.
4. After purging the calculated purge volume, use a hand bailer to collect the sample (see FSOP: 3.06 Bailer Sampling).
5. Collect and handle samples following the procedures outlined in FSOP: 3.01.
6. Decon between each unique sample location, unless clean, dedicated equipment is used at each sample location.

Faucets, Taps, Valves

A. Application

This sampling technique is used when sampling groundwater from a valve or faucet. The sample should be collected prior to any water treatment such as chlorination or softening.

B. Limitations

The sample water is subject to contamination from the pipes and valves, i.e. iron, copper, lead or plastics from pipes and oils or greases from valves and pumps.

C. Safety

Avoid splashing water.

D. Equipment Composition

Sampling equipment is not used. Bottles are filled directly from the valve or faucet.

E. Checklist

Sample bottles
Gloves
Cooler and ice
Logbook

F. Procedures

1. Examine the water lines and determine where the sample should be taken. Strainers, aerators and hose attachments should be removed and/or cleaned.
2. Open valve or faucet (cold water only). Adjust flow to a moderate pressure to prevent splashing or aeration of the water. Allow sufficient time for the well to be purged or the lines to be flushed clean of rust or residue (approximately 15 minutes). Do not adjust flow during sampling.
3. Collect and handle samples following the procedures outlined in FSOP: 5.01.

Deluxe DC Purge Pump

FSOP: 5.11

Date: April 1, 1997

Revision #: _____

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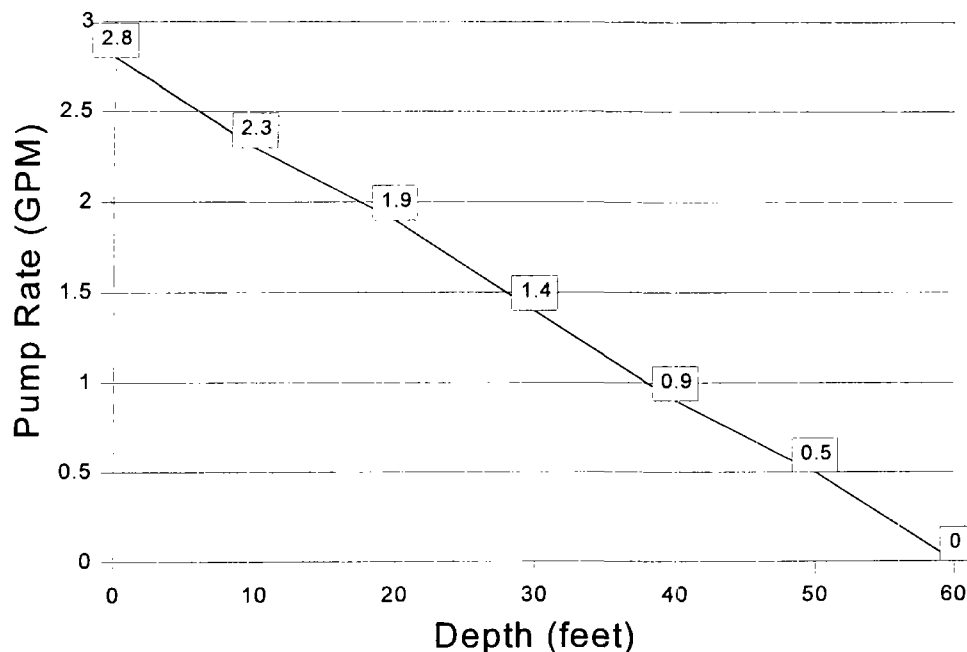
A. Application

The Deluxe DC Purge Pump is a rotary stroke pump used for purging monitoring wells or shallow ponds.

B. Limitations

This pump is only effective at depths less than 60 feet. The pump rate varies with depth; 2.8 GPM maximum, 0.0 GPM at 60 feet (see graphic below). Sand and silt may permanently damage pump. NO NOT run the pump dry. DO NOT use with 12V vehicle battery while vehicle is running.

Deluxe DC Purge Pump Output



C.

Safety

This pump is not intrinsically safe.

D. Equipment Composition

The pump casing is made of ABS plastic with synthetic rubber seals. The impeller is made of stainless steel. The tubing (3/8" ID or 1/2" ID with adaptor) must be purchased separately; a nylon reinforced PVC is recommended by the manufacturer. The power source is a 12 volt vehicle battery or deep discharge marine battery which is also purchased separately.

E. Checklist

DC Purge Pump
Tubing
12V Marine Battery (fully charged!!)
Deionized (DI) Water
Buckets for catching purge water
Disposal of purge water

F. Procedures

1. Cut tubing to desired length and attach to pump (be sure tubing and pump do not touch the ground or become contaminated).
2. Lower pump into well and into the water column. Support pump by tubing and NOT by power line.
3. Connect the pump power line to the battery to start the flow.
4. Prime the pump by cycling the pump on and off in 4 second intervals several times.
5. When purging is complete, disconnect from battery before raising pump out of water column.

Decontamination Procedures

1. Tubing can be either disposed of or decontaminated.
2. Rinse with DI water in the field.
3. Mix tap water with a small amount of detergent (i.e. Alconox) and pump through. Rinse well with DI water.
4. Clean sand and silt out of the bottom strainer.

** Note: The pump is completely sealed and no attempt should be made to open the pump.

T-L-C meter. YSI Model 3000

FSOP: 6.01

Date: April 1, 1997

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Approved by: _____

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A. Application

The YSI Model 3000 T-L-C meter measures temperature, water level or depth, conductivity, and temperature-compensated conductivity. The probe is designed to fit into well boreholes, but can also be used in general surface water applications. Conductivity of solutions is referenced to 25 C. Instrument has temperature-compensated conductivity ranges, to automatically correct the reading to 25 C.

B. Limitations

Temperature: Maximum error between the measuring limits of -5.0 C and 50.0 C is +0.3 C.

Conductivity: Maximum instrument error(not including temperature error) in either range is $\pm 3\%$. (i.e. - 20.00m mhos /cm, $\times .03 = +.60\text{m mhos/cm}$). This represents the combine instrument and probe errors.

Temperature Compensated Conductivity: Maximum error in either range is $\pm 4\%$ of the full scale range limit. This represents the combined instrument, probe, and temperature errors.

Level: Maximum error for depth measurement is ± 1 inch/50 feet. This represents the combined errors due to the cable markers, the scale on the label and the cable stretch when fully suspended in a well casing.

C. Safety

This meter is not intrinsically safe.

D. Equipment Composition

The probe and cable have many plastic components which are incompatible with the decontamination solutions.

E. Checklist

T-L-C meter YSI Model 3050 test probe and reel assembly
6 "C" cell batteries
Deionized (DI) water

F. Procedures

I. Operating Procedures

Temperature:

1. Set the function switch to C.
2. COMPLETELY submerge the probe in the water to be measured.

Never put the probe into the sample bottle that will be sent to the lab.

3. Allow 40 to 60 seconds for the probe to come to temperature equilibrium with the water.

4. After the reading has stabilized, read the displayed temperature value.

Conductivity:

1. Set the function switch to $2\mu/\text{cm}$.
2. Completely submerge the probe, allowing 10 to 20 seconds for it to reach equilibrium with the water.
3. If the display reads "1. _", then the conductivity is greater than $1.999\mu/\text{cm}$. Reset the switch to $20\mu/\text{cm}$. If the overrange signal is still displayed, the conductivity is greater than $19.99\mu/\text{cm}$ and can not be measured without dilution.
4. After the reading has stabilized, observe the displayed conductivity value.

Level or Depth:

1. Read FSOP: 3.02. Depth to Water Level Measurement.
2. Set the function switch to any of the conductivity modes.
3. Lower the probe into the well or borehole until the displayed value suddenly rises from about zero to some higher value. The probe begins to measure conductivity when the conductivity cell electrodes just touch the water. At this point the reading will be about one half of the actual conductivity. When the probe is completely submerged, the reading will be about double the value displayed at the original contact point, where the probe just touches the water.
4. Raise the probe slowly out of the water until the displayed value goes back to approximately zero.
5. Lower the probe very slowly until the reading rises suddenly to about one-half the full conductivity value.
6. To determine the water level, compare the cable mark to the reference point on the well casing. Read the approximate distance to water from the probe cable, then use the scale printed on the instruction label on the back of the instrument to measure any additional distance to the cable mark. Note that the scale is calibrated in tenths of an inch (or in half centimeters) to make it easy to add or to subtract units from the cable length interval.

II. Shut-down procedures

1. Turn the function switch to off.
2. Clean the probe and cable thoroughly by rinsing with distilled water and wiping with a wet paper towel. Stubborn residues may be cleaned with isopropyl alcohol. Minimize the contact and contact time for any cleaning solvents.

III. Instrument Calibration Check

The YSI 3050 Probe is calibrated at the factory. YSI 3167 or 3168. Conductivity Calibrator Solution (10 μ /cm) can be used as a calibration check on the instrument as follows :

1. Rinse the probe with some of the calibrator solution to remove any contamination. Be certain that the bottle is still at least half-full.
2. Immerse the probe in the solution and switch to either 2 μ /cm TC to 25 C or 20 μ /cm TC to 25 C according to the range necessary for the solution used.
3. Note the displayed value. Probe/instrument accuracy can be determined by comparing this to the conductivity calibrator solution value. If the displayed value is within 4% of the calibrator value, the system is within specification and can be used. If the error is greater than 4%, the instrument should be tested with the YSI 3040 test probe (see instrument manual). If it passes these tests replatinize the probe. (see manual). The following formula can be used to make a corrected determination of improved accuracy.

$$\text{Corrected Sample Value} = \frac{\text{Calibrator Value}}{\text{Value Displayed}} \times \text{Sample Value}$$

4. After use, the calibrator solution is contaminated and should be discarded.
5. The instrument may be returned to the factory for calibration.

IV. Documentation

The following information must be recorded in the instrument calibration and test log and possibly in the site specific log book for calibration check.

1. Instrument name and model
2. ID or serial number
3. Date and time of calibration check
4. Method of calibration check and calibration check temperature
5. Results of calibration check
6. Name of calibrator

V. Cleaning the Probe and Cable

1. The probe and cable must be cleaned between samples by rinsing with distilled water or wiping with a wet paper towel.
2. Stubborn residues may be cleaned with a wet paper towel.
3. Dirty probes may contaminate samples and cause conductivity to change. Do not take a measurement from the sample bottle. Foaming acid tile cleaners such as Dow Chemical "Bathroom Cleaner" can be used to clean the probe. For a stronger solution, use equal parts of isopropyl alcohol and 10 N HCl in a solution.
4. Do not clean the probe in aqua regia or any other solution which may etch platinum or gold.

5. Dip the probe in cleaning solution and agitate for 2 or 3 minutes. Rinse the probe thoroughly in distilled water. Inspect the platinum black electrode coating to determine whether replatinizing is required (refer to manual for further instructions). Replatinizing is necessary if cleaning does not restore probe performance, or if flaking or other defects in the platinum black coating are apparent. Replatinizing requires the use of a YSI 3045 Platinizing Instrument and YSI Platinizing Solution. CAUTION: Do not use anything to touch the electrodes inside the probe body. Platinum black is soft and can be easily scraped off.

6. The instrument casing may be cleaned with soap and water or alcohol. Do not use ketones or chlorinated solvents, as these may damage the case.

VI. Battery installation

1. Rotate the reel handle to uncoil about one foot of the probe cable.
2. Using a screwdriver or coin, turn the 1/4 turn screw on the instrument face counterclockwise.
3. Remove the electronics and probe reel assemblies from housing and disconnect the probe connector (on back of electronics assembly) by turning its sleeve counterclockwise.
4. Remove the probe reel from the electronics assembly.
5. Remove the nine screws located on the back of the electronics assembly. Separate the front and back halves, being careful not to damage the O-rings that provide watertight integrity.
6. Install the batteries, observing the correct polarity (red indicators mark the positive terminal). Turn the unit on to make sure that the instrument is working before reassembly.
7. Remove, dry and replace the dessicant container, or install a new one (except on the initial installation).
8. Reassemble the instrument, being careful not to damage or misalign the O-rings.

VII. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	As needed (when it is suspected that the instrument is out of calibration).
Cleaning the probe	Rinse between samples. Clean thoroughly after use with a cleaning solution if needed.
Replace batteries	When BAT appears in the upper left corner of the display.

Replace or dry dessicant	When internal condensation occurs.
Replace seal	When seal integrity is broken.
Remove batteries	When the instrument is stored for more than a few months.
Replatinize the probe	When cleaning does not restore probe performance or if flaking or other defects in the platinum black coating are apparent (refer to manual for further instructions).

VIII. Troubleshooting

1. BAT appears in upper left corner of display. Approximately 8 hours of use remain. Replace batteries. Six batteries are needed and may be six heavy duty "C" cell batteries (providing about 1200 hours of use) or alkaline batteries (providing about 1700 hours of use).
2. Meter does not calibrate reasonably well to calibrator solution.
 - (a). Inspect the platinum black electrode coating to determine if replatinizing is necessary. Follow manufacturer's instructions.
 - (b). Contact a YSI service representative.

Digital Conductance, Temperature
and PH Tester

FSOP: 6.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

A. Application

The Digital Conductance, Temperature and PH Tester is used to measure conductivity, temperature, and pH of aqueous solutions. Conductance is measured in 4 ranges: 0 to 20 μ /cm, 0 to 200 μ /cm, 0 to 2,000 μ /cm, 0 to 20,000 μ /cm. The range of pH is 0 to 14; and temperature is 0 to 160°F (2.5 to 70°C).

B. Limitations

Conductivity \pm 2%, full scale at 77°F (25°C)

Temperature \pm 2°F (1°C)

pH units at 77°F (25°C)

** The main unit is **NOT** waterproof DO NOT immerse or splash water on the face of the unit. This may corrode the circuit boards and render the unit inoperative.

C. Safety

This meter is not intrinsically safe.

D. Equipment Composition

E. Checklist

Digital Conductance, Temperature and PH Tester

Buffer solutions pH 4.0, pH 7.0, pH 10

Distilled or Deionized (DI) water

F. Procedures

I. Operations Procedures

1. Rinse the inside of sample cup with liquid to be measured. (This is especially important if a sample with a wide range of conductivity or pH is to be measured.)
2. Fill sample cup. DO NOT get the main unit wet.
3. Fill sample cup at least 2/3 full. If the sample is hot water, allow to cool to 160°F or below.
4. Slip the right hand function switch to "TEMP" and push the "READ" button. If temperature reading is not stable, empty and refill the cup several times to bring cup and sample to the same temperature.
5. Read the temperature on the digital display panel and adjust both temperature compensation knobs accordingly.
6. If the approximate conductance is known, slide the left hand range selector switch to the proper range. Example: if you expect the sample to be around 2000 μ , slide the left hand range selector switch to x1000.
NOTE: If "1" appears on the readout, the conductance is higher than selected range. Move the range selector switch until a 3 or 4 digit number appears (1.0 or larger). If a decimal number (like 0.11) appears, move the range selector switch until a 3 or 4 digit number appears (1.0 or larger).
7. Slide the right hand function switch to "COND" and push the "READ" button.

8. Multiply the digital display reading by the factor indicated by the position of the left hand range selector switch to determine conductance. Example: A display reading of 1.00 with left hand range selector switch indicating x1000 is: 1.00×1000 or $1000 \mu/\text{cm}$.
9. Slip the right hand function selector to "pH".
10. Insert the pH cable connector onto the tester. Push on and twist clockwise.
11. Remove plastic storage cap slowly.
12. Place the pH electrode in the sample cup or any nonmetallic container holding the remainder of the sample to be measured.
13. Press the "READ" button: pH value will appear on the digital display.
14. Always obtain conductivity reading before placing pH probe in sample cup. pH probes tend to carry contamination over into. Always replace the cap (moistened with water) of the electrode while not in use.

II. Calibration

1. Temperature and conductance are factory calibrated. To recalibrate see instruction manual.
2. To standardize the pH, place the pH electrode in the 7.0 buffer solution.
3. Adjust the "ZERO" potentiometer of the face of the tester so that the digital display indicates 7.00.
4. Rinse electrode in distilled water and place the pH electrode in the 4.0 or 10.0 buffer solution. Adjust the "SLOPE" potentiometer of the face of the tester so that the digital display indicates the buffer chosen.

III. Maintenance

Battery Replacement:

Replace the battery whenever "LO BAT" appears on the display. The battery is located behind the snap-off cover on the bottom of the tester. Use a small tool to pop out the cover. Replace battery with the 9 volt alkaline.

Sample Cup:

Wipe the cup after every sample and rinse with DI water. The carbon electrodes in the cap may be cleaned with a mild abrasive, 400 grit or finer on the end of a flat surface.

Water Level Indicator
Solinst 101-P4

FSOP: 6.03
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 1

A. Application

The Solinst 101-P4 is used to measure the water level and well depth in monitoring wells.

B. Limitations

The tape line is 300 feet long.

C. Safety

This meter is not intrinsically safe.

D. Equipment Composition

The tape is a 3/8th width polyethylene tape with seven stainless steel conductors embedded in the tape. The probe is stainless steel.

E. Checklist

Water Level Indicator
Extra 9v battery
Deionized (DI) Water
Wipes
Logbook

F. Procedures

I. Operating Procedures

1. Turn the rotary dial clockwise to turn on the meter.
2. Depress the small black button to check battery and tone level. Adjust by turning the dial.
3. Lower the probe into the well. The probe will "buzz" when water is reached. Be sure to record the reading.
4. To get a well depth measurement, turn off the meter and lower into the well until the bottom is reached. Record the reading.

II. Care of the Meter & Probe

1. After each usage, carefully wind the tape while wiping down with a wipe moistened with DI water.
2. For the periodic cleaning of the probe, see the instructions on the following page.

III. Battery Replacement

1. Use an alkaline 9 volt battery.
2. The battery is housed in the reel hub. To remove, unscrew the three faceplate screws and carefully lift off to the side to avoid damaging the wiring.
3. Replace the battery then replace the faceplate of the reel and the screws, making sure the wires are completely inside.

Sample Collection
Technique for Soils

FSOP: 7.01
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

A. Application

Used for the collection of all soil samples, no matter what type of equipment is used for the physical collection of soil.

B. Limitations

Samples may be collected by non-mechanical, physical means to depths as deep as 20-25 feet depending on the sample collection method.

C. Safety

D. Equipment Composition

Preferred equipment: Stainless Steel (SS) for metal or organic analyses.

Preferred sample container: Wide-mouth glass jar with a Teflon® lined lid. Glass may be clear, but should be amber for photo sensitive chemical compounds.

E. Checklist

SS Spoons - new or decontaminated
SS compositing pan - new or decontaminated
Sample container(s) with label(s) - clear or amber glass
Cooler & ice
Logbook

F. Procedures

1. Complete the bottle label before filling with soil.
2. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOA's first, Semi-Vol's second, Pesticides/PCB's third, and metals last.
3. Soil for volatile organic analyses can be placed directly into sample bottle with a pre-cleaned stainless steel spoon. Make sure to pack soil tightly into bottle, filling all possible voids or air spaces. Fill the sample container by quarters, packing down the soil with the spoon as each quarter is placed into sample jar. Fill the jar to the very top. Do not agitate the soil or expose to aeration by the wind.
4. Soil for other analyses (semi-volatiles & metals) are homogenized in a clean SS pan with the SS spoon or equivalent. When necessary, protect the sample from wind blown dust, rain, etc., and protect from warming, especially samples for organic analyses. You can cover the pan with aluminum foil for protection, but avoid contact with the sample, especially samples to be analyzed for metals.

5. After filling, clean the threads and lip of the bottle with a clean wipe (Soft Cote or Kim Wipe). Do not touch the sample with the wipe or gloves. Check that the liner in the bottle cap is present before tightening the cap onto the bottle. If required, placed the glass sample containers in sealable plastic bags.
6. Preserve the sample (usually by putting on ice) as soon as possible after filling, cooling to 4° C. Some samples for organic analysis need to be protected from light by using amber bottles and/or by placing in a cooler. Since lids tend to loosen after containers are cooled, retighten after having been on ice for about 30 minutes.
7. Make sure all applicable sections in the log book are filled out properly. If possible, Chain-Of-Custody forms must be completed by the samplers before leaving the site. Ship the samples as soon as possible to minimize sample holding time.
8. Back fill the hole with unused soils. In some situations it may be desired to fill the boring with bentonite flakes or pellets (e.g., when using augers for deeper samples).
9. For documentation purposes, photograph the area with the sample containers next to sample location.

Surface Soil Sampling
by Spoon or Scoop

FSOP: 7.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 1

- A. **Application**
Simplest and most direct method for sampling soils.
Can be used in most soil types.
- B. **Limitations**
Limited somewhat to shallow soil horizons (0-6 inches).
- C. **Safety**
Be aware of sharp object (glass, nails) which may be present in soil being sampled.
Avoid direct dermal contact with soils being sampled.
- D. **Equipment Composition**
Equipment composed of stainless steel (SS) is preferred.
Acceptable with reservations: hardened steel or chrome plated for non-metal analyses.
- E. **Checklist**
SS Spoon or Scoop - clean or decontaminated
SS pan - clean or decontaminated
Aluminum foil
Decontamination supplies, if applicable
Cooler & ice
Sample Bottles
Logbook
- F. **Procedures**
1. Clear the area to be sampled of any surface debris (i.e., rocks, leaves, twigs, litter, etc.).
 2. Using a pre-cleaned stainless steel spoon or scoop, it is advisable to remove the first $\frac{1}{4}$ to $\frac{3}{4}$ inch of surface soil in a 6 inch radius around the sample location. This will prevent near-surface soil particles from falling down the hole once you start digging.
 3. Carefully remove the top layer of soil to the desired depth with a precleaned spoon or scoop.
 4. If a shovel was used to reach the desired depth, use a pre-cleaned stainless steel spoon or scoop to remove and discard a thin layer of soil from the area which came in contact with the shovel.
 5. Collect and handle samples following the procedures outlined in FSOP 7.01, Sample Collection Techniques for Soils.

Soil Sampling with a Bucket Auger

A. Application

Can be used where small rocks are present.
Fast - large soil volume.
Samples can be collected from surface to as deep as 25 feet or more, depending upon soil types.
Can use in conjunction with core tubes.
Can use in a wide variety of soil conditions.

B. Limitations

Does not provide an undisturbed sample.
Bore hole may collapse, especially in sandy soils.
Heavy clays may be difficult to remove from bucket.
Sandy, gravelly soils may not stay inside bucket.

C. Safety

Can be labor intensive with deeper sampling.
Disposable gloves will sometimes tear with the pressure needed to turn augers.
Holes produced from augering may need to be backfilled with bentonite (flakes or pellets).

D. Equipment Composition

Preferred: Stainless Steel for metal or organic analyses.
Acceptable with reservations: Alloys or hardened steel, without paint if sampling for organics, or if those equipment parts do not come into contact with the sample (i.e., auger extensions or cross handles).

E. Checklist

SS Spoons	Cross handle
SS compositing pan	Sample Bottles
Aluminum foil	Decontamination supplies, if necessary
Augers	Cooler & ice
Quick-connect extensions	Bentonite (pellets or flakes)
Extension separator tool	Sample containers

F. Procedures

1. Clear the area to be sampled of any surface debris (i.e., rocks, leaves, twigs, litter, etc.).
2. It may be advisable to remove the first $\frac{1}{2}$ to $\frac{3}{4}$ inch of surface soil for an area approximately 6" in radius around the sample location to prevent near-surface soil particles from falling down the hole.
3. Attach bucket auger and cross handle to an auger extension.
4. Begin drilling/augering, periodically removing accumulated soils from the bucket. If compositing, empty the accumulated soil into a clean SS or aluminum pan.

5. Should depths greater than one extension bar length be desired, simply remove the T-handle using the extension separator tool and attach another extension bar. The 3-foot extension bars are the easiest to work with.
6. After reaching the desired depth, carefully remove auger from boring without knocking surficial soils into the bore hole.
7. For very exacting sampling at a desired depth, you may want to use a planer auger to clean out the loose dirt and flatten the bottoms of pre-drilled holes.
8. After reaching the desired depth, use a clean auger, carefully lowering it into the boring and auger until enough sample is obtained or until auger is full. You may want to use a smaller size auger. Carefully remove auger from the boring.
9. Collect and handle samples following the procedures outlined in FSOP 7.01, Sample Collection Techniques for Soils.
10. Do not decontaminate the auger if you are compositing from the same hole. You must decontaminate between each unique sample location. However, this does not apply if you are using a clean, dedicated auger at each sample location.
11. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOA's first, Semi-Vol's second, Pesticides/PCB's third, and metals last.
12. Backfill the hole with unused soils. In some situations it may be desired to fill the boring with bentonite flakes or pellets.

**Soil Sampling with Coring
Tube and Hammer Attachment**

FSOP: 7.04

Date: April 1, 1997

Revision #:

Approved by:

Page 1 of 2

A. Application

Fast

Can use in conjunction with augers or bucket augers.

Provides a relatively undisturbed sample from a pre-augered hole.

Preferred when collecting for volatiles.

B. Limitations

Small sample volumes

Depth of sample: 0-12 inches or length of core tube

Rocks can be major obstacles

Sample can be compressed

Success is greatly dependent on soil type (i.e., cohesive structure & stratigraphic characteristics)

C. Safety

Disposable gloves will sometimes tear with the pressure needed to turn augers; replace gloves when needed.

Holes produced from augering may need to be backfilled with bentonite (flakes or pellets).

D. Equipment Composition

Preferred: Stainless Steel for metal or organic analyses.

Acceptable with reservations: Alloys or hardened steel, without paint if sampling for organics, or if those equipment parts do not come into contact with the sample (i.e., auger extensions or cross handles).

E. Checklist

SS Spoons	Cross handle
SS Pan	Sample Bottles
Aluminum foil	Decontamination supplies, if necessary
Augers	Sample containers
Coring tubes	Cooler & ice
Quick-connect extensions	Bentonite (pellets or flakes)
Hammer attachment	Extension separator tool
Logbook	

F. Procedures

1. Clear the area to be sampled of any surface debris (i.e., rocks, leaves, twigs, litter, etc.).
2. Attach coring tube and hammer attachment to an auger extension bar.
3. A planer auger may be used, if desired, to clean out the loose dirt and flatten pre-augered bore holes before soil coring.

4. Insert coring tube and extension bar(s) into boring hole. Use the hammer attachment to drive core tube to the desired depth. If possible, prevent soil from falling into the bore hole and the collapse of the bore hole. If more sample volume is needed, disconnect coring tube, attach an auger and auger to the ending depth of the last core tube before attempting another core sample.
5. Collect and handle samples following the procedures outlined in FSOP 7.01, Sample Collection Techniques for Soils.

Spilt Spoon

A. Application

Sample tube can be split into two equal halves.

Large volume - 2-3 inches diameter and 1 1/2-5 feet long.

Usually hammered into soil ahead of the auger when installing a monitoring well, but can be used from a tripod or manually with a sledge hammer.

A basket-like sample retainer can be fitted into the lower end of the tube to hold loose samples.

The number of blows of the hammer is an indicator of the density of the substrate.

Continuous corings can be taken.

B. Limitations

Usually made of hardened steel, stainless steel is preferred.

Equipment is heavy.

C. Safety

Cannot be operated in wet weather.

D. Equipment Composition

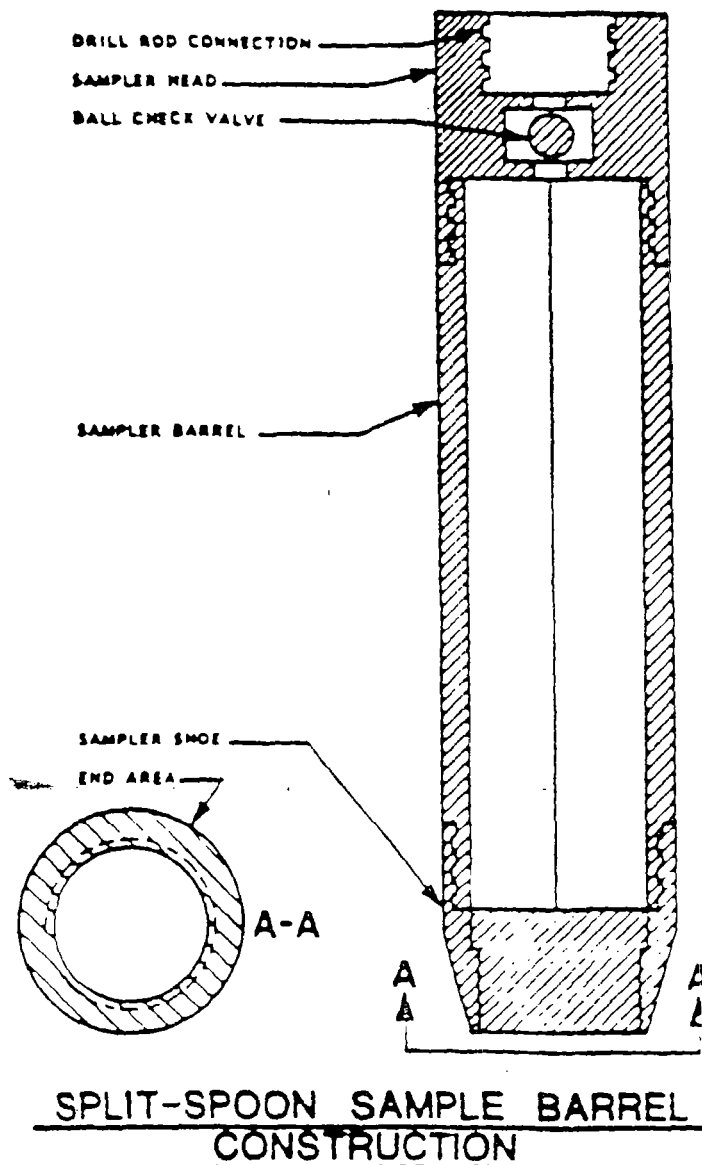
Preferred: Stainless Steel for metal and organic analyses.

Acceptable: Hardened Steel without paint.

The basket-like sample retainers are sometimes made of plastic and should not be used for collecting samples for organic analysis.

E. Checklist

Split spoons	Bentonite	Tripod
Large pipe wrenches	Drive head	Pulley
SS Spoons	Driver (weight)	Rope
SS pans	Drill rod	Sledge hammer
Al foil	Cooler and ice	Bottles
Decontamination supplies		



CONSTRUCTION OF SPLIT SPOON SAMPLE BARRELS

BARRELS ARE GENERALLY 45 TO 61 CENTIMETERS LONG AND CONSIST OF TWO INTERLOCKING HALVES. TO GAIN ACCESS TO THE SAMPLES, THE END CAPS WHICH HOLD THE BARREL HALVES TOGETHER ARE REMOVED AND THE BARREL IS "CRACKED" OPEN. TUBES CAN BE INSTALLED IN THE BARREL SO THAT SAMPLES CAN BE REMOVED UNDISTURBED.

F. Procedures

1. Use an auger to advance the bore hole to the desired depth.
2. Clear the area to be sampled of any rocks, twigs or debris.
3. Attach the split spoon sampler to the correct length of drill rod and hammer the sampler to the desired depth.
4. Retrieve the sample and detach from the drill rod.
5. Remove the sampler shoe (nose piece) and head (pipe wrenches will probably be needed). Discard the top 1-2 inches when sampling in bore holes. This portion is usually the disturbed soil that was at the bottom of the bore hole.
6. Soil for volatile organic analyses can be place directly into the bottle. Soil for other analyses are homogenized in a clean SS pan with a clean SS spoon or equivalent. When necessary, protect the sample form wind blown dust, rain, etc., and protect from warming, especially samples for organic analyses. You can cover the pan with Al foil for protection, but avoid contact with the sample, especially samples to be analyzed for metals.
7. Complete the bottle label before filling with soil. Bottles for volatile organic analysis should be filled to the very top. Exclude air pockets by tamping or gently compacting the soil as the bottle is filled. Do not agitate the soil or expose to aeration by the wind.
8. Clean the threads and lip of the bottle with a paper towel (Soft Cote or Kim Wipe). Do not touch the sample with the paper towel or gloves. Check the liner in the bottle cap before tightening the cap onto the bottle.
9. Clean the outside of the bottle with water and/or a paper towel. Attach sample tags when needed.

10. Preserve the sample (usually by putting on ice) as soon as possible after filling. Some samples for organic analysis need to be protected from light by using amber bottles and/or by putting in the cooler.
11. If possible, Chain-of-custody forms must be completed by the samplers before leaving the site.
12. Samples must be packaged and shipped according to DOT regulations when applicable. At a minimum, samples must be packaged to prevent breakage.
13. Sampling equipment must be decontaminated between each unique sample and before leaving the site. Care should be taken when decontaminating the sampler head because decontamination fluids can be trapped by the check valve.

**Soil Screening Using
the Backsaver™ Corer**

FSOP: 7.06
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

- A. **Application**
Sub-surface soil investigation
Field screening of shallow soils for physical and/or chemical parameters
Checking depth of shallow water tables.
- B. **Limitations**
Small sample volumes
Sampling depth limited by length of push rod (46") - extensions are available.
Poor performance in rocky, gravelly, or non-cohesive soils.
- C. **Safety**
Foot-operated handle enables operator to get deep soil samples with less risk of back injury.
- D. **Equipment Composition** (Figure 1)
Stainless steel
- E. **Checklist**
SS Spoon or Scoop - clean or decontaminated
SS pan - clean or decontaminated
Field screening instrumentation (i.e., photoionization detector)
Logbook
- F. **Procedures**
1. Clear the area to be sampled of any surface debris (i.e., rocks, leaves, twigs, litter, etc.).
 2. Steady the soil probe in a nearly vertical position by grasping the handgrip with both hands.
 3. Force the sampling tube into the soil by stepping firmly on the footstep.
 4. Remove the first section of the core by pulling upward on the handgrip. Grasp the handgrip with both hands, but move head to one side so that the upper extension of the unit does not strike the chin of the operator.
 5. Empty the sampling tube and clean (see "Cleaning of the Soil Sampling Tube").
 6. Place the sampling tube in the original hole and push into the soil until the footstep is within an inch or two of the surface of the ground.
 7. While maintaining a slight pressure on the footstep, pull upward on the handgrip until the footstep has been elevated 6 to 8 inches above the surface of the ground.

8. Maintain a slight upward pressure on the handgrip and step downward on the footstep. The footstep now grips the rod and the sampling tube can be pushed into the soil until the footstep is within 1 to 2 inches above the ground.
9. Steps 7 and 8 are repeated until the sampling tube is full. The depth of penetration can be determined by the position of the rod end which can be seen through the viewing holes in the side of the square portion of the Backsaver handle. It is important not to push the sampling tube into the soil to a depth that exceeds the holding capacity of the tube as this jams the sample and can make removal from the ground extremely difficult. Figure 2
10. Remove the full sampling tube by lifting upward on the handgrip. After the tube has been elevated 6 to 8 inches, push downward on the handgrip returning the footstep to within 1 to 2 inches of the surface of the ground. Repeat this action until the sampling tube is out of the ground.
11. Empty the sampling tube and clean. Repeat steps 6 through 10 until the desired depth is reached.
12. Upon reaching desired depth, collect and handle soil samples following the procedures outlined in FSOP 4.01, Sample Collection Techniques for Soils.

G. Cleaning of the Soil Sampling Tube:

Proper cleaning of the soil tube insures two things:

- (1) Greatly reduced lifting pressures
- (2) A better soil core.

First, clear the trough portion of the sampling tube by inserting part A (Figure 3) into the exposed sample and pulling part A along the length of the trough.

Second, remove the end plug from the sampling tube by placing part B over the end of the plug and pulling on the end of the cleaner.

Third, after the sampling tube is clear of soil, use part C of the probe cleaner as follows: Apply a thin coat of vegetable oil to the inside of the sampling tube using the C-2 portion of the special cleaner. Use the C-1 portion to apply a thin film to the outside. Work a film of oil into the tip using one's fingers. The nylon mesh covered sponge, part C, should be filled with vegetable oil each day. Vegetable oil is recommended because it is harmless to the skin and washes off easily with soap and water. Once in a while, the sponge should be washed thoroughly using a liquid detergent.

Heath LS-500 Pipe and Cable
Locating System

A. Application

The Heath LS-500 Pipe and Cable Locating System is designed to locate buried underground utilities. Additionally, by using the Heath LS-500 Operating Handle (optional accessory), the operator can make fast preliminary surveys to locate individual objects, manholes, steel drums, underground storage tanks, valve boxes and other buried metal targets.

This Standard Operating Procedure addresses, the Inductive or Indirect mode, "on Handle" approach, since searching for buried drums, tankers and underground storage tanks is the primary use for the Division of Emergency and Remedial Response.

B. Limitations

The on-handle approach is not a precise locate. It should only be used when obtaining the general location of the conductor.

C. Safety

The Heath LS-500 is an electronic instrument and should be treated as such. This instrument is not intrinsically safe.

D. Equipment Composition

Heath LS-500 and Operating Handle.

E. Checklist

Heath LS-500
Operating handle

F. Procedure

1. Connect the handle with the single screw tightly to the TRANSMITTER.
2. Connect the handle with the two screws to the RECEIVER. Note: the screw (knob) on the operating handle next to the meter is the balance adjust knob. Fasten this knob with 4-5 turns, but don't not tighten completely.
3. Set the transmitter to the normal signal position.
4. Pull the transmitter Power switch to the ON position.

5. Range selector on the Receiver should be set to the LO position.
6. Pull the receiver power switch to the ON position.

The instrument can now be balanced. It is necessary to be outdoors in an area at least 15-20 feet away from other conductors (i.e. chain link fences, guard rails, railroad tracks or other utilities)

7. Hold the operating handle (with the transmitter and receiver attached and adjusted per above) at arms length and parallel to the ground.
8. The sensitivity control knob must remain lined up with the orange line for the following balancing procedure.
9. Turn the balance adjust knob (knob nearest to the meter) clockwise to obtain no audio signal and a zero reading on the meter. Now adjust this knob slightly counterclockwise until a slight audible tone and meter reading is obtained. The unit can now be considered balanced.
10. The instrument is now balanced and ready for use. To be effective, the operator must cross the conductor at right angles. By doing this, the operator will receive the loudest audio response and the meter will read full scale. At the point of the strongest response, make a mark under the center of the operating handle, then continue to walk in the same until no signal registers. At this point, turn around and walk back over the same path repeating above procedure (making a second mark). The conductor will be buried midway between the two marks.

Schönstedt GA-52C Magnetic Locator

FSOP: 8.02

Date: April 1, 1997

Revision #: _____

Approved by: _____

Page 1 of 2

A. Application

The Schönstedt magnetic detector can be used to detect buried objects such as drums, survey markers, manholes, septic tanks, well casings, and other pieces of buried metal.

B. Limitations

The GA-52C can detect objects to a depth of approximately eight feet below the ground surface. Keep the unit out of water. The GA-52C detector will not detect non-magnetic materials such as brass, aluminum, copper, gold, and silver.

C. Safety

Follow manufacturer's recommendation for safe use of this product and refer to site-specific Health and Safety Plan. The GA-52C is not intrinsically safe. A burbling sound made by the detector indicates the presence of an energized power line.

D. Equipment Composition

Schönstedt GA-52C Magnetic Locator. The unit is powered by four "D" size batteries. These batteries should be removed if the unit is not used for an extended period of time.

E. Checklist

GA-52C Unit
Log book

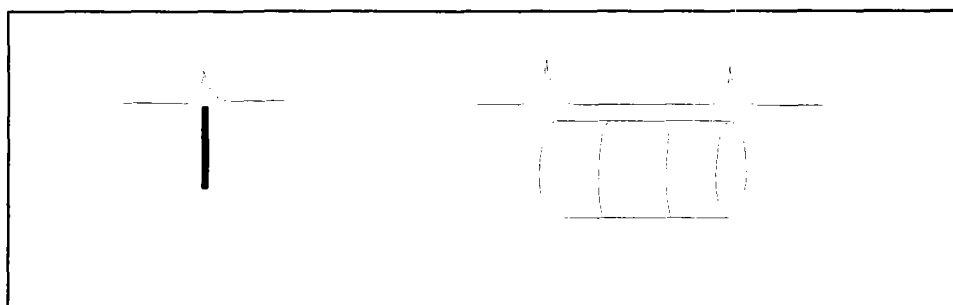
F. Procedures

1. Using the circular knob turn the unit on, and adjust the volume by rotating the control in a clockwise direction.
2. Using the wedge shaped sensitivity control, adjust the sensitivity to mid-range. There is no maintenance or calibration necessary.
3. Hold the detector by the detecting tube just below the control box. Make sure metal watches are removed.
4. To obtain maximum area coverage, sweep detector from side to side. Hold detector away from steel-toe boots.
6. When detector comes within range of a metal object, a higher frequency will be heard on the speaker.

FSOP: 8.02

7. After you have detected the presence of a target, hold the locator vertically (with the control box up) and move it back and forth over the suspected area in an "X" pattern. The highest frequency signal will be heard directly over a vertically oriented target, and over the ends of a horizontal target. See figures.

Frequency Spikes



8. If there is too much background noise from small objects such as nails, raise the tip of the detector further above the ground to reduce noise and focus on larger objects.

Schönstedt GA-52C Magnetic Locator

FSOP: 8.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 2

A. Application

The Schönstedt magnetic detector can be used to detect buried objects such as drums, survey markers, manholes, septic tanks, well casings, and other pieces of buried metal.

B. Limitations

The GA-52C can detect objects to a depth of approximately eight feet below the ground surface. Keep the unit out of water. The GA-52C detector will not detect non-magnetic materials such as brass, aluminum, copper, gold, and silver.

C. Safety

Follow manufacturer's recommendation for safe use of this product and refer to site-specific Health and Safety Plan. The GA-52C is not intrinsically safe. A burbling sound made by the detector indicates the presence of an energized power line.

D. Equipment Composition

Schönstedt GA-52C Magnetic Locator. The unit is powered by four "D" size batteries. These batteries should be removed if the unit is not used for an extended period of time.

E. Checklist

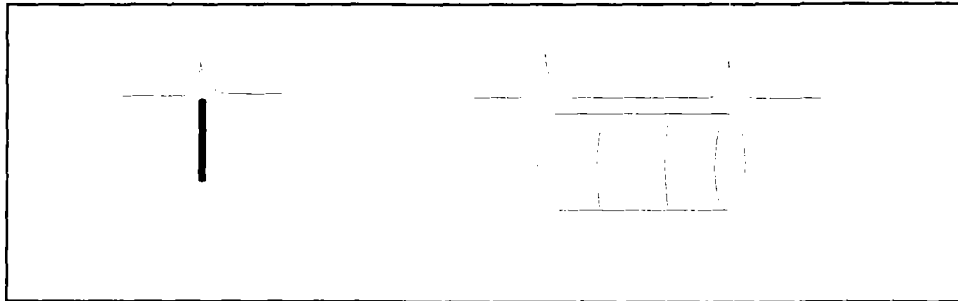
GA-52C Unit
Log book

F. Procedures

1. Using the circular knob turn the unit on, and adjust the volume by rotating the control in a clockwise direction.
2. Using the wedge shaped sensitivity control, adjust the sensitivity to mid-range. There is no maintenance or calibration necessary.
3. Hold the detector by the detecting tube just below the control box. Make sure metal watches are removed.
4. To obtain maximum area coverage, sweep detector from side to side. Hold detector away from steel-toe boots.
6. When detector comes within range of a metal object, a higher frequency will be heard on the speaker.

7. After you have detected the presence of a target, hold the locator vertically (with the control box up) and move it back and forth over the suspected area in an "X" pattern. The highest frequency signal will be heard directly over a vertically oriented target, and over the ends of a horizontal target. See figures.

Frequency Spikes



8. If there is too much background noise from small objects such as nails, raise the tip of the detector further above the ground to reduce noise and focus on larger objects.

Sample Collection Technique
for Sediments

FSOP: 9.01
Date: April 1, 1997
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Approved by: _____
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A. Application

Used for the collection of all sediment samples, no matter what type of equipment is used for the physical collection of sediment.

B. Limitations

Samples may be collected by non-mechanical, physical means to depths as deep as 5-10 feet depending on the sample collection method.

C. Safety

Refer to the site-specific Health & Safety Plan

D. Equipment Composition

Preferred equipment: Stainless Steel (SS) for metal or organic analyses.

Preferred sample container: Wide-mouth glass jar with a Teflon® lined lid. Glass may be clear, but should be amber for photo sensitive chemical compounds.

E. Checklist

SS Spoons - new or decontaminated
SS compositing pan - new or decontaminated
Sample container(s) with label(s) - clear or amber glass
Cooler & ice
Paper Towels
Logbook
Sample Gloves

F. Procedures

1. Complete the bottle label before filling with soil.
2. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOA's first, Semi-Vol's second, Pesticides/PCB's third, and metals last.
3. Sediment for volatile organic analyses can be placed directly into sample bottle with a pre-cleaned stainless steel spoon. Make sure to pack soil tightly into bottle, filling all possible voids or air spaces. Fill the sample container by quarters, packing down the soil with the spoon as each quarter is placed into sample jar. Fill the jar to the very top. Do not agitate the sediment or expose to aeration by the wind.
4. Sediment for other analyses (semi-volatiles & metals) are homogenized in a clean SS pan with the SS spoon or equivalent. When necessary, protect the sample from wind blown dust, rain, etc., and protect from warming, especially samples for organic analyses. You can cover the pan with aluminum foil for protection, but avoid contact with the sample, especially samples to be analyzed for metals.

5. After filling, clean the threads and lip of the bottle with a clean paper towel. Do not touch the sample with the paper towel or sample gloves. Check that the liner in the bottle cap is present before tightening the cap onto the bottle. If required, placed the glass sample containers in sealable plastic bags.
6. Preserve the sample (usually by putting on ice) as soon as possible after filling, cooling to 4° C. Some samples for organic analysis need to be protected from light by using amber bottles and/or by placing in a cooler. Since lids tend to loosen after containers are cooled, retighten after having been on ice for about 30 minutes.
7. Make sure all applicable sections in the log book are filled out properly. If possible, Chain-Of-Custody forms must be completed by the samplers before leaving the site. Ship the samples as soon as possible to minimize sample holding time.
8. For documentation purposes, photograph the area with the sample containers next to sample location.

Eckman Dredge

FSOP: 9.02
Date: April 1, 1997
Revision #: _____
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A. Application

Easiest to use of dredges; and easy to set and light weight. Ideal for sediments which consist of soft mud, silt, or sand bottoms.

Can use extension handle in shallow water or rope with a messenger for deep water.

B. Limitations

Difficult to use where gravel, rock, or organic litter is prevalent and where strong currents are encountered. Possible disturbance of surface film of the substrate; can be overcome by lowering gently through the last 1-2 feet. Water column entrapped above Eckman may wash out some sediment when lifting out of the water. Somewhat difficult to decontaminate.

C. Safety

The jaws of an eckman are spring loaded and are attached to a trip mechanism; when tripped the jaws come together with force. When in the closed position the springs can easily be unhooked. Unhook springs when decontaminating the dredge.

Refer to manufacturer's recommendations and Site Specific Health & Safety Plan.

D. Equipment Composition

Stainless steel is preferred; however, brass can be used for only non-metal analyses.

E. Checklist

Eckman and messenger	Pole, or rope
SS pan	SS Spoons
Aluminum foil	Sample Gloves
Cooler and ice	Log Book

F. Procedures

1. Complete the bottle label before filling with water. Bottles should be filled according to the volatility of the contaminants to be analyzed: VOCs, Semi-VOCs, PCB/Pesticides, Metals. Don sampling gloves and appropriate protective equipment. Preserve the sample vials with the appropriate preservative for that specific sample analysis.
2. Submerge the sample vial for volatile organic analysis (VOA) below the water surface. Hold the vial upside down while submerging.

Minimize disturbance of the surface. While the vial is submerged, slowly turn the vials upright allowing the vial to fill and reach equilibrium. Fill the vial far enough below the water surface so that the surface film on the water is not incorporated into the sample. This surface film may contain a lot of organic matter which may or may not be volatile organics. If the water is flowing, point the bottle opening upstream.

3. Hold bottles for other analyses upside down while submerging. Minimize disturbance of the surface. While the bottle is submerged, slowly turn the bottle upright allowing the bottle to fill and reach equilibrium. While the vial is submerged, slowly turn the vials upright allowing it to fill to the desired volume (to the shoulder for most bottles for adequate ullage to allow for expansion). Fill the bottle far enough below the water surface so that the surface film on the water is flowing, point the bottle opening upstream.
4. Place the cap on the VOA vial while submerged. Check the teflon coated septum's orientation, make sure the teflon side is on the sample side. Bottles for other analyses do not have to be capped while submerged. Invert the VOA vial and gently tap to verify that there are no air bubbles entrapped in the sample vial. If air bubbles are present, resample using a new VOA vial.
5. Clean the outside of the bottle with water and/or a paper towel. Attach sample tags when needed.
6. Preserve the sample on ice as soon as possible after filling, cooling to 4°C. Some samples for organic analysis need to be protected from light by using amber bottles and/or by placing in a cooler. Since lids tend to loosen after containers are cooled, retighten after having been on ice for about 30 minutes.
7. Make sure all applicable sections in the log book are filled out properly. If possible, Chain-of-Custody forms must be completed by the samplers before leaving site. Ship the samples as soon as possible to minimize sample holding time.
8. For documentation purposes, photograph the area with the sample containers next to sample location.
9. Collect and Handle samples following the procedures outlined in FSOP 9.01, **Sample Collection Technique for Sediment Sampling.**

Hand Sediment Corer

FSOP: 9.04

Date: April 1, 1997

Revision #: _____

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A. Application

This sediment sampling coring tube is best used in soft mud, silt or sand. It can be used manually, with an extension rod or with a rope. The corer is two inches in diameter and 20 or 30 inches long. The core catcher and flapper valve help prevent loss of sample.

B. Limitations

This tool cannot be used where gravel, rock, organic debris or compacted sediment are prevalent.

The substrate surface film may become disturbed when lowering the dredge through the water column. This can be minimized by lowering the dredge gently through the last 1-2 feet of the water column.

The core catcher is difficult to decontaminate.

The core catcher may interfere with sample collection in areas containing very soft sediment.

C. Safety

The sampler is usually very "dirty," and needs to be handled with gloves to remove the core sample.

D. Equipment Composition

Stainless steel corers are preferred; although, brass corers may be used for samples where non-metal analyses will be performed. The core catcher, although stainless steel, is soldered to the corer which may interfere with metals analyses.

E. Checklist

Hand Sediment Corer	Core tube
Nose piece	Drive head
Extension pole	Cooler and ice
Sample bottles	Rope
SS pan	SS spoons
Aluminum foil	Sample Gloves

F. Procedure

1. Attach the necessary length of rope or extension pole.
2. Lower corer through the water column to the sediment, causing minimal disturbance to the final 1-2 feet of water. Press firmly so the corer penetrates the sediment, securing a sediment sample.
3. Lift the corer to the surface with a smooth, even motion.
4. Empty contents of corer into a clean stainless steel pan.

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5. Collect and handle samples following the procedures outlined in **FSOP: 9.01, Sample Collection Technique for Sediment Sampling.**
6. Decon between each unique sample location, unless a clean, dedicated corer is being used at each sample location.

Vibra Core Sediment Sampler

FSOP: 9.05

Date: April 1, 1997

Revision #: _____

Approved by: _____

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A. Application

Soft Mud, silt or sand bottoms

Can be used by hand or with a 12 volt DC battery vibrator and mount.

Corer is 6 foot in length and 2 inches in diameter, Cellulose Acetate Butyrate (CAB) polymer tube with a core catcher attached to help prevent loss of sample.

B. Limitations

Cannot be used where gravel, rock, organic debris, or compacted sediments are prevalent.

C. Safety

Field crew personnel should always wear appropriate personal protective clothing and equipment including a life jacket if sampling from a boat or near water.

The intention of this clothing is to minimize personal exposure to the possible hazardous sediments.

The field crew will consist of at least 3 and the buddy system will be followed.

D. Equipment Composition

Pole coring system consisting of:

1. Stainless steel core tube mounting barrel with check valve
2. Retrieval lines
3. 10 foot extension pole
4. 6 foot by 2 inch diameter cellulose acetate butyrate (CAB) polymer core tube with core catcher
5. 4-2 inch diameter end caps
6. Optional equipment: 12 volt DC vibrator and mount for attachment to the extension pole and 12 volt DC battery.

E. Checklist

Vibra Core	Pole
SS pan	SS spoons
Aluminum Foil	Cooler & Ice
Log Book	Permanent Marker
Gloves	Life Jacket if (applicable)

F. Procedures

1. Double anchor the sampling vessel at the desired sampling location. Document the position with the Global Positioning System (GPS) (or other type of the location device) or/and triangulation off local landmarks.
2. Measure the water depth with appropriate means.
3. Attach the necessary retrieval lines to the core tube mounting barrel. Attach other end of the lines to the sampling vessel.
4. Insert a 6 foot length of 2 inch diameter CAB core tube (core catcher end down) into the mounting barrel and tighten the threaded nose piece using the two pipe wrenches.
5. Attach the extension pole to the mounting barrel. Attach the optional vibrator unit to the other end of the extension pole.
6. Lower the coring system vertically (CAB tubing first) into the water to the sediment. Push or vibrate the tube into the sediment to the desired sampling depth or until refusal. Note the insertion length of the pole.
7. Disengage the extension pole and stow on board sampling vessel.
8. Retrieve the core tube containing the sample by pulling on the two retrieval lines.
9. With the tube and barrel held vertical in the boat, use the portable drill to drill a 1/4" hole in the CAB coring tube, just above the sediment column to allow the water to drain.
10. Cut off the tube just above the sediment surface and cap both ends. (Be careful not to cause disturbance to the sediment column.) If the sample in the tube is longer than 3 feet (1 meter), cut and cap again at 3 feet (1 meter) above the catcher end.
11. Label the tube lengths with sample station identification codes with a permanent marker; make use the upper ends are marked as such.
12. Stow the core sample tube(s) in the ice cooler (partially filled with ice) for preservation. Transport the core sample tubes ashore for the core subsample processing as soon as possible.
13. Transport ashore core sample tubes. Sample core tube will be preserved by either refrigeration or in an ice cooler at 4° C until analyzed.

14. Decontaminate the sampling equipment between each sample station.
15. Collect and Handle samples following the procedures outlined in FSOP 9.01, **Sample Collection Technique for Sediment Sampling.**
16. **Subsampling the Core**

Subsampling of the core sediment sample may be somewhat subjective to the objective of sampling event. Typically, the core section inside its CAB tube is laid on a stainless steel processing table or counter next to a ruler. The tube is cut open lengthwise by scoring it deeply on both sides with a router bit or other cutting device. Remove all plastic shavings and/or chips from the processing table prior to making the final cut. The final cut through the tube wall is made by hand with a sharp stainless steel blade utility knife. (Note: This method will prevent contaminating the sample with plastic chips caused by a router.) While scoring the tube, a trough-device is used to hold the tube in place. Once the core tube is split open a description of the layers for each core is recorded in the Core Observation Log. (Optional photographs may also be taken of each layer or 1 foot interval to provide additional documentation of the core sample.) After documentation process the core subsample are collected from the undisturbed core interior with a stainless steel spoon or spatula. The pre-determined amount of sediment sample collected from each core interval will be placed into a labeled wide-mouth jar. Each sample jar will be properly labeled with the unique station identification code, with a suffix indicating the layer (i.e. X cm- Y cm) of the sample. Decontaminate the stainless steel processing table prior to proceeding with the next core sample.

Grain Thief

FSOP: 10.01

Date: April 1, 1997

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A. Application

This hand-held tool can be used to sample powders, pellets or grains. Grain Thiefs are made in a variety of sizes.

B. Limitations

Limited to the length of the sampler.

C. Safety

The Grain Thief is pointed on the end.

Refer to the Site Specific Health & Safety Plan

D. Equipment Composition

Stainless steel Grain Thiefs are preferred; although brass and aluminum are available for non-metal analyses.

E. Checklist

Grain Thief	Sample Gloves
SS pan	SS spoon
Cooler and ice	Log Book

F. Procedures

1. Insert the thief, while in the closed position, into granular or powdered waste. When possible, insert diagonally from the top edge, through the center and to the opposite bottom edge.
2. Open the thief by rotating the inner tube. Wiggle the thief to allow the sample to enter the open slots.
3. Close the thief and withdraw from the material being sampled.
4. Position the thief horizontally with the slots facing upward. Rotate the outer tube and slide it out and away from the inner tube.
5. Empty the contents of the inner tube into a clean stainless steel pan.
6. Collect and handle samples following the procedures outlined in FSOP: 4.01, Sample Collection Technique for Surface Water Sampling.
7. Decon between each unique sample location, unless a clean, dedicated thief is being used at each sample location.

Coliwasa

FSOP: 11.01
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A. Application

This sampling tube is recommended for sampling multiphase wastes from drums and other containers.

Low density fluids are easier to retain in a coliwasa than a glass tube.

Most coliwasa are reusable, but disposables are available.

See the BCI Drum Inventory form at the end of this section for an example of the information required for a drum inventory.

B. Limitations

The coliwasa is difficult to decontaminate in the field.

Coliwasa's are more expensive than glass tubing.

C. Safety

Splashing or glass-breakage may pose certain hazards during sampling; therefore, gloves, face shields, boot covers and protective clothing should be worn.

A minimum of a two-person team is recommended when sampling drums and containers.

Leave the area immediately if a reaction occurs (smoke, light, bubbling, etc.) when inserting the coliwasa into a drum or container.

If the coliwasa becomes cloudy or frosted, hydrofluoric acid is present, and a plastic coliwasa should be used to collect the sample.

If solids are encountered in a drum or container, another method should be used to collect a sample of this material, i.e. corer, scoop, spoon, etc.

D. Equipment Composition

Coliwasa's are available in glass, teflon and polyvinyl chloride.

The coliwasa consists of an outer glass or plastic tube with an inner, moveable glass or plastic rod.

E. Checklist

Coliwasa	Bung wrench
Sample Gloves	Face shield (optional)
Boot covers	Protective clothing (acid splash suit or
Log Book	Saranex)

F. Procedures

1. After inspecting the drum or container, carefully open the bung or remove the lid. If the drum or container is under pressure, carefully and slowly vent. If opened quickly, there is a possibility that the liquid inside will spray out. Pressure may be manifested by hissing or bubbling around the bung or lid when loosened.
2. Slowly insert the coliwasa, in the open position (inner glass rod not seated in the opening at the end of the coliwasa), to the bottom of the drum or container, allowing it to fill as it is lowered.
3. Lock the sampler in the closed position (inner glass rod seated in the opening), so the sample will remain in the coliwasa.
4. Slowly raise the coliwasa out of the drum or container. Place the lower end of the coliwasa into the sample bottle, and slowly release the liquid into the bottle by raising the inner rod from its seated position. Make certain that the volume in the coliwasa will not overfill the bottle.
5. Break the coliwasa (if disposable) in a way as to contain all glass fragments.
6. Replace bung or lid.
7. Decon between each unique sample location, unless a clean, dedicated coliwasa is being used at each sample location.

Bacon Bomb/Tank Sampler

FSOP: 11.02

Date: April 1, 1997

Revision #: _____

Approved by: _____

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A. Application

This sampler is designed to sample liquids at different levels in a tank. The sample can be a composite from different levels, or grab samples can be taken from discrete levels.

This technique is best suited for sampling viscous liquids. Alternate methods should be used for sampling solids or sludges.

Some tank samplers are designed to open at the bottom of the tank or at different depths while on extension rods.

B. Limitations

Bacon Bombs are somewhat difficult to decontaminate.

C. Safety

Splashing may pose certain hazards during sampling; therefore, gloves, face shields, boot covers and protective clothing should be worn.

A minimum of a two-person team is recommended.

Leave the area immediately if a reaction occurs (smoke, light, bubbling, etc.) when lowering the sampler into the tank.

D. Equipment Composition

Bacon Bombs are usually chrome-plated brass or bronze with a rubber O-ring in 8, 16 and 32 ounce sizes. Stainless steel or stainless steel and teflon are preferred.

E. Checklist

Bacon Bomb or Tank Sampler	Bung wrench
Sample Gloves	Face Shield (optional)
Boot covers	Log Book
Protective clothing (acid splash suit or Saranex)	

F. Procedures

1. Attach the necessary length of sampler line and plunger line to the sampler. Measure and mark the sampling line for the desired depth(s).
2. Slowly lower the sampler in the closed position into the tank to the desired depth(s).
3. Pull the plunger line to fill the sampler. A composite sample can be taken by holding the plunger open for equal lengths of time at different depths.

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4. Release the plunger line to seal the sampler. Raise the sampler to the surface being careful not to pull on the plunger line.
5. Clean the outside of the sampler with DI water and or paper towel when necessary. Any liquids on the outside of the sampler should not be included in the sample.
6. Place the lower end of the sampler into the sample bottle, and slowly release the liquid into the bottle. Make certain that the volume of the sampler will not overfill the bottle.
7. Decon between each unique sample location, unless a clean, dedicated sampler is being used at each sample location.

Glass Tubes

FSOP: 11.03
Date: April 1, 1997
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Approved by: _____
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A. Application

Generally, 1/4 to 5/8 inch diameter glass tubes are used to collect liquid samples from drums and containers. Larger diameter tubes may be used for more viscous liquids.

Glass tubes are a quick, simple and relatively inexpensive way to collect liquid samples without generating contaminated equipment.

The bottom of the tube can be tapered or a suction device (pipet bulb) can be used to assist in sampling.

See the BCI Drum Inventory form at the end of this section for an example of the information required for a drum inventory.

B. Limitation

Low density fluids are difficult to retain in the glass tubes.

The broken tube in the drum may complicate the treatment or disposal of the drum contents.

C. Safety

Splashing and glass-breakage may pose certain hazards during sampling; therefore, gloves, face shields, boot covers and protective clothing should be worn.

A minimum of a two-person team is recommended.

Leave the area immediately if a reaction occurs (smoke, light, bubbling, etc.) when inserting the coliwasa into a drum or container.

If the coliwasa becomes cloudy or frosted, hydrofluoric acid is present, and a plastic coliwasa should be used to collect the sample.

If solids are encountered in a drum or container, another method should be used to collect a sample of this material, i.e. corer, scoop, spoon, etc.

D. Equipment Composition

Glass tubing is used for most sampling. Plastic tubing is used for samples containing hydrofluoric acid. Stoppers can be made of teflon or rubber.

E. Checklist

Glass tubing (assortment of diameters)
Rigid plastic tubing
Bung wrench
Face shield (optional)

Sample Gloves
Boot covers
Protective clothing (acid splash suit or Saranex)
Stoppers (teflon or rubber)
Sample bottles

F. Procedures

1. After inspecting the drum or container, carefully open the bung or remove the lid. If the drum or container is under pressure, carefully and slowly vent. If opened quickly, there is a possibility that the liquid inside will spray out. Pressure may be manifested by hissing or bubbling around the bung or lid when loosened.
2. Slowly insert the glass tube to the bottom of the drum or container, allowing the tube to fill as it is lowered. When the tube is at the bottom, there should be about a foot of tubing above the drum or container.
3. Cap the top of the tubing with a gloved finger or thumb or a stopper.
4. Place the open end of the tubing into the sample bottle, and slowly release the liquid into the bottle by releasing your finger or stopper. Make certain that the volume in the tubing will not overfill the bottle.
5. Break the tube in the drum in a way as to contain all glass fragments.
6. Replace bung or lid.

Wipe Sample Collection

A. Application

Wipe samples for PCBs (polychlorinated biphenyls) are collected to determine the presence and concentration of PCBs on smooth and impervious surfaces. The quantity determined by the laboratory is referenced against the surface area of the wipe sample, usually 100 cm². This type of sampling is quantitative only when a known area is wipe sampled. Analytical results are reported as micrograms of PCB in the sample per the area sampled (e.g, 10 ug/100 cm²). Any other sampling is qualitative and only indicates the presence of surface contamination.

B. Limitations

Wipe sampling is inappropriate for non-impervious or porous surfaces (e.g., asphalt, wood and plasterboard).

C. Safety

This sampling method involves the use of flammable and/or combustibles solvents.

Dermal exposure to PCBs can cause chloracne.

Exposure to PCBs has been linked to cancer and other long term health effects.

D. Equipment Composition

For PCB, use 11 cm diameter Whatman GF/A filter paper (glass microfibre), with the appropriate solvent (HPLC or pesticide grade).

E. Checklist

cotton swabs (3"x 3" or 4" x 4" sterile gauze pads) or 11 cm absorbent filter papers (Whatman 40 ashless or Whatman 50 smear tabs)

sterilized glass containers (jars or vials)
container of iso-octane, pentane, hexane or any other solvent in which PCBs are at least 5% soluble by weight

an eye dropper

disposable cardboard template (10 cm x 10 cm opening)

disposable surgical (1 pair per sample)

plastic disposal bags

seals and labels

indelible or permanent markers

F. Procedures

1. Use PPE appropriate to the situation.
2. Identify the area to be sampled in the field notes. Photograph the area, if possible.
3. Using the eyedropper, thoroughly wet the swab with solvent or dip clean cotton swab in solvent (approximately 5 cc per 3" x 3" swab). Do not over saturate the swab.
4. Thoroughly swab the 100 cm² sample area within the template. Using medium pressure, swab in a horizontal direction with one side of the pad and repeat in a vertical direction with the other side of the pad. Completely wipe the sample area twice.
5. Place the sample in the glass jar and secure the lid on the jar.
6. Label and seal the container and log the sample on the chain of custody and in the field notes. Place the samples in storage at 4°C.*
7. Place any contaminated or potentially contaminated equipment in a plastic bag for disposal.
8. At the end of sampling, prepare a control blank by going through these steps WITHOUT swabbing the surface.

* Placing samples on ice is optional when dealing with PCBs only. PCBs are normally stable in wipe samples; however, to minimize the effects of temperature, pH and bacterial action, samples should be protected from high temperatures and sunlight.

Combustible Gas Indicator (CGI)
Oxygen Meter

FSOP: 13.01
Date: April 1, 1997
Revision #:
Approved by:
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A. Application

The Action Levels for the CGI are as follows:

<10% LEL	-Continue monitoring with caution
10-25%	-Continue monitoring with extreme caution
>25% LEL	-Explosion Hazard; withdraw from area immediately
<19% O ₂	-Monitor wearing SCBA. NOTE: Combustible gas readings are not valid in atmospheres <19.5% oxygen.
19.5-25% O ₂	-Continue monitoring with caution. SCBA not needed based only on oxygen content.
>25% O ₂	-Discontinue monitoring. Potential fire hazard! Consult specialist.

This instrument is designed to measure combustible gases and vapors in air (to determine flammability hazard) and percent oxygen (to determine if sufficient oxygen is present to support life). The combustible gases or vapors are measured as percent Lower Explosive Limit (LEL) with a range of 0 to 100%. Oxygen is measured as percent present with a range of 0 to 25%.

Operating range for relative humidity is 10 to 90% RH. Operating range for temperature is 0 to 104 degrees Fahrenheit (-18 to 40 degrees Centigrade) for combustible gas and oxygen if calibrated at the temperature of use. If the CGI is not calibrated at the temperature of use, the operating range for oxygen is 32 to 104 degrees F (0 to 40 degrees C).

Alarm concentrations are indicated by red lights and an audible alarm. The zero and calibration controls have "life-to-adjust" knobs to prevent any accidental change in adjustments.

Approximate flow rate is 1.5 liters per minute.

A fully charged battery provides at least eight hours of continuous, non-alarm operation at normal temperature.

A low oxygen reading may indicate displacement of air by another gas or consumption of oxygen by some process or reaction.

B. Limitations

The CGI will not measure combustible gas or vapor in an inert gas or in any mixture with less than 10% oxygen.

The CGI should not be used in oxygen enriched atmospheres (where the oxygen concentration exceeds that of fresh air). In oxygen enriched atmospheres, combustible gases and vapors are easier to ignite, and

normally non-combustible materials, gases and vapors may now be combustible.

Silanes, silicone, silicates (often found in hydraulic fluids) and organic lead compounds (leaded gasoline) tend to "poison" the combustible gas sensor and cause erroneously low readings. Frequent calibration checks should be performed if these materials are suspected to be present.

The CGI will not detect combustible airborne mists or ducts such as lubrication oils, coal dust or grain dust.

High or low atmospheric pressure will cause error in percent oxygen readings. The instrument oxygen meter should be calibrated at the elevation where monitoring is to take place.

Acid gases such as carbon dioxide (greater than one percent) will shorten the life of the oxygen sensor. The effect of carbon dioxide on the oxygen sensor is cumulative; therefore, monitoring of atmospheres containing excess concentrations of carbon dioxide should be discontinued as soon as a constant reading is obtained. Normal life of the sensor is approximately one year.

High concentrations of combustible gas will cause the meter to indicate a reading greater than 100% LEL, and the meter will latch at full scale. The "latching" circuit can be reset by moving to an area of fresh air. If the needle deflects to the extreme right, then quickly returns to a position within the scale or below zero, this indicates that the gas concentration has exceeded the Upper Explosive Limit (UEL).

The CGI has a tolerance of 40%. For example, a reading of 20% LEL could be as high as 28% or as low as 12%.

Fuming acids, such as sulfuric and nitric acids, also "poison" the detection filament.

C. **Safety**

Do not operate the CGI while it is connected to the battery charger. Do not charge the battery in areas that may contain combustible gases, vapors or dust, because the ignition source created during charging could cause an explosion.

The calibration gas tank contents are under pressure. Do not store near heat or flame.

Although an atmosphere may not present a flammability hazard, it may still be toxic to humans. The LELs for many gases are far above the threshold limit values (TLVs).

Calibrate before each field use. Calibrate and establish background reading in an area known to be free of combustible gases and vapors.

Do not switch the CGI on or off unless in a known, combustible-free atmosphere.

Strong oxidants such as fluorine, chlorine and ozone will give erroneously high oxygen readings when concentrations exceed 0.5% (5,000 ppm).

Do not touch the oxygen sensor with hands or objects; the membrane is easily damaged.

D. Equipment Composition

The CGI is UL rated for intrinsic safety only for use in hazardous locations Class 1, Groups A, B, C and D when used with battery pack. Do not switch on or off unless in a known combustible-free atmosphere.

E. Checklist

CGI
Charged Battery
Calibration Gas
Regulator
Tubing
Calibration Logbook
Operating Manual

F. Operating Procedures

The Model 261 CGI should be calibrated and zeroed in an uncontaminated atmosphere (fresh air).

1. Open the instrument lid and turn the center ON-CFF control to the HORN OFF position. Both meter pointers will move, and one or both alarms may light.
2. The percent LEL meter pointer should be set to zero by adjusting the ZERO LEL control. Adjustment should be made within 30 seconds after the instrument is turned on; this is to prevent accidental activation of the meter latch circuit.
3. If the percent oxygen meter pointer stabilizes at a value other than 20.8%, the pointer should be set to 20.8% by using the CALIBRATE O₂ control.
4. Press the ALARM RESET button; the alarm(s) should reset, and

the green pilot light should flash.

5. Momentarily place a finger over the sample inlet fitting or the end of the sample line probe. Observe that the flow indicator float drops out of sight, indicating no flow. If the float does not drop, check the flow system for leaks as described in Troubleshooting.
6. Press the CHECK button and observe the percent LEL meter. The pointer must read 80% LEL or higher as marked by the BATTERY zone on the meter. If the pointer reading is less, the battery pack must be recharged; no tests should be attempted as the instrument will malfunction. See MAINTENANCE for battery charging instructions.
7. Turn the ON-OFF control to the ON position. The pilot lamp should light continuously.
8. Accessory equipment such as sampling lines, probes, carrying harness, filters or line taps should be attached as required. Tighten all connections and test for flow indication by blocking flow at the far end of the sampling system. If the flow indicator float does not drop, check all connections and test again. If the float still does not drop, check the internal flow system as described in Troubleshooting.
9. The CGI is now ready for atmospheric sampling.

G. Calibration Procedures
Combustible System Calibration Check

Before the calibration of the CGI can be checked, it must be in operating condition (see Operating Procedures). Calibration check adjustment is made as follows:

1. Check and zero the instrument, as described in Operating Procedures.
2. Attach the flow control to the recommended calibration gas tank. Do not use oil, grease or flammable solvents on the flow control or the calibration gas tank.
3. Connect the adapter hose to the flow control.
4. Open flow control valve.

5. Connect the adapter hose fitting to the inlet on the instrument. After approximately 15 seconds, the LEL meter pointer should be stable and within the range specified on the calibration sheet accompanying the calibration equipment. If the meter pointer is not in the correct range, stop the flow and remove the right hand side speaker panel. Turn on the flow and adjust the "S" control with a small screw driver to obtain the reading specified on the calibration sheet.
6. Disconnect the adapter hose fitting from the instrument.
7. Close the flow control valve.
8. Remove the adapter hose from the flow control.
9. Remove the flow control from the calibration gas tank.
10. Replace the side panel on the CGI.
11. Note the conversion factors below and their relationship to readings from a CGI calibrated to pentane.

Oxygen System Calibration Check

Make an oxygen system calibration check each time a combustible gas check is made.

H. Documentation

The following information must be recorded in the instrument calibration and test log and possibly in the site specific logbook for calibration.

1. Instrument name and model
2. ID or serial number
3. Date and time of calibration
4. Method of calibration
5. Results of calibration
6. Identification of calibration gas (source, type, concentration lot number, span setting)
7. Name of calibrator

I. Sample Inlet Filter/Filter Element

The sample inlet filter should be examined each time the Model 261 is recharged. If the filter element appears to be coated with dust or dirt, it should be washed, dried and reinserted or a new element substituted. If a new element is installed, also install a new filter O-ring. Make sure the inlet seal O-ring in the inlet filter cap is properly seated. If O-ring is damaged or missing, replace it before using the CGI with any sampling accessories.

CONVERSION FACTORS

Chemical	Conversion Factor
Acetone 1.0	
Acetylene	0.8
Benzene 1.1	
Iso-Butane	1.0
n-Butane	1.0
Butadiene	0.8
Butene-1	1.0
Carbon Monoxide	0.6
Ethane	0.7
Ethyl Acetate	1.1
Ethyl Alcohol	1.0
Ethylene	0.8
Ethylene Oxide	0.9
Ethyl Ether	1.1
Gasoline	1.0
Heptane 1.1	
Hexane	1.3
Hydrogen	0.6
Methane 0.6	
Methyl Alcohol	0.7
Methyl Ethyl Ketone	1.6
Pentane 1.0	
Propane 0.9	
Propylene	1.0
Propylene Oxide	1.0
Isopropyl Alcohol	1.1
Tetrahydrofuran	0.8
Toluene 1.2	

Example:

When the HNU is calibrated to pentane, but used to monitor for propane, the conversion factor is 0.9. If the meter reads 50% LEL, the true propane concentration is $50\% \times 0.9$ or 45% LEL.

The curves presented in the manual are typical of this instrument which had been calibrated on pentane. The response of a particular instrument may be higher or lower than the stated response. For this reason, an accuracy tolerance of plus or minus 25% should be applied in the interpretation of any meter response.

Printed Circuit Board Adjustment

The printed circuit board contains five adjustment points:

Oxygen Sensor Adjustment

- O₂H: The Oxygen High Alarm Point adjustment (factory-set at 23% oxygen)
- O₂L: The Oxygen Low Alarm Point adjustment (factory-set at 19.5% oxygen)
- O₂ The Oxygen Offset controls the zero reading of the oxygen meter. The leads to the oxygen cell must be disconnected and shorted together, and the front panel CALIBRATE O₂ knob turned fully clockwise. The percent oxygen meter should indicate zero. Adjust OFFSET as necessary.

Combustible Gas Sensor Adjustment

- CGA: The Combustible Gas Alarm Point adjustment (factory-set at 25% LEL)
- S: After zeroing, the Span is adjusted by sampling calibration check gas and adjusting the readout accordingly.

Battery Pack Charging

The primary maintenance item of the CGI is the rechargeable, 4.0 volt lead-acid battery. Upon receiving a new CGI, the battery pack must be fully charged, per the following procedure. Using the appropriate battery charger (120 VAC, Part No. 631664, or 240 VAC, Part No. 631712), insert charger plug into charge jack.

The POWER ON lamp indicates that the charger is receiving power from the 120 or 240 VAC line. The FAST CHARGE lamp indicates that the battery voltage is low and that the charger has automatically switched to the higher charge rate. When the battery is approximately 95% charged, the charger will change to the trickle charge rate and the FAST CHARGE lamp will be extinguished.

Recommended charging time is 14 hours. The battery pack may be left on charge for longer periods without damage. The battery pack may not supply full power capacity after repeated partial use between chargings; therefore, it is recommended that the battery pack be "exercised" at least once per month by operating the CGI for eight to ten hours and then recharging. The battery pack should be charged after each day of use (or prior to use if the instrument has not been operated for 30 days).

Oxygen Sensor Installation

1. Remove the carrying handle by loosening both knurled screws and spreading the handle beyond the collars. Lift it from the screw shafts.

2. Remove the left side of the case (the end with the threaded inlet fitting) by removing the four mounting screws. Slowly draw the side away from the case as far as the connecting wires permit. NOTE: Remove the case lid and set aside.)
3. Slide the top panel approximately three inches from the remainder of the case.
4. Open the protective bag containing the oxygen sensor and install the O-ring onto the threaded end of the sensor.
5. Firmly screw the sensor into the manifold by hand so as to compress the O-ring, thereby preventing sample flow leakage.
6. Push the connectors onto the two terminals at the top of the sensor. NOTE: Connect the gray wire to the positive (+) terminal and the yellow wire to the negative (-) terminal.
7. Reassemble the case by sliding the top panel back into position. NOTE: The top and case fit together by two dovetail-type tongue-and-grooves. Be sure to align both carefully before sliding the panel onto the instrument. The panel should slide on easily. If resistance occurs, the tongue-and-grooves are positioned incorrectly.
8. Place the case side in position, and install the lid hinge pins into each side.
9. Install the mounting screws. NOTE: Insert all four screws loosely before tightening any one of them.
10. Reattach the handle.
11. See Troubleshooting Guidelines and Oxygen Calibration for instructions on leak testing the sample flow system and adjusting the oxygen calibration.

J. **Maintenance and Calibration Schedule**

<u>Function</u>	<u>Frequency</u>
.Perform routine calibration	.Prior to each use
.Charge battery 14 hours, run instrument for 8-10 hours, fully charge battery 24-36 hours (4.0v lead-acid battery)	.As a regular monthly maintenance for optimum battery service

- | | |
|--|--------------------------------|
| .Recharge battery for a minimum of
of 14 hours. The battery pack
can be left on the charger for
longer periods without damage | .After each day of use |
| .Check inlet filter for dust or
dirt coating | .After each day of use |
| .Replace oxygen sensor | .Normal life is approx. 1 year |

K. Troubleshooting

Difficulties with the CGI can be localized by disassembling the instrument and performing the following tests:

1. Disconnect any accessories attached to the site of the instrument case.
2. Loosen knurled screws holding the handle and remove handle.
3. Remove both sides of case by removing the two sets of four screws. Remove instrument lid and set aside. Slowly draw the sides away from the case as far as the connecting wires allow.
4. Disconnect molded nylon plugs for the battery and the speaker.
5. Slide the battery out of the case.
6. All of the remaining components and wiring are bolted to the top panel of the case. This panel can be removed as a unit by simply sliding the assembly from the extruded sides of the case.
7. For troubleshooting purposed, the battery (and speaker, if desired) can be reconnected after the instrument is removed from the case.

Flow System

A leak in the flow system is indicated when flow continues after the inlet is blocked. Block off the flow at the pump inlet by pinching the tubing with pliers to ensure that the pump stalls. If the pump stalls, remove the inlet filter cap and filter element and place a finger over the opening. If the pump then stalls, the O-ring in the inlet cap should be replaced. If the pump does not stall when the inlet opening is blocked, inspect the condition of the pump assembly, tubing, barbed hose fitting and its O-ring and the O-ring behind the filter adapter. Replace any worn or damaged parts. A blockage in the flow system is indicated when the float does not rise in the panel indicator. Remove any sampling line and, if this does not allow the flow to resume, examine the sample inlet filter for blockage or dirt. Clean or release the filter element if necessary. If the flow is not replaced by either of these procedures, the pump assembly should be inspected and/or replaced.

HNU, Model PI 101
Photoionization Detector

FSOP: 13.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
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A. Application

Action levels to determine level of protection must be set before using a HNU (see FSOP: 1.01 for action levels).

The HNU is a nonspecific portable photoionization detector (PID) which responds to both organic and inorganic gases and vapors.

The HNU contains an ultraviolet (UV) light source which ionizes compounds if the ionization potential (IP) of the compounds in air are equal to or lower than the energy of the UV light source (see table of Ionization Potentials).

The units of measure for IP are electron volts (eV). Three light sources are available for the HNU 10.2 eV (standard), 9.5 or 11.7 eV (optional). The ionization of the compound detected must be less than the electron volt energy of the light source. As the IP approaches the eV energy of the light source, more energy is needed; therefore, less of the compound is detected. For example, when using a 10.2 eV lamp, a compound with an IP of 10.1 eV would be detected at lower concentrations than actually present.

A fully charged battery will provide 12 to 14 hours of power to operate the HNU. Instrument operating time is reduced at lower temperatures due to temperature sensitivity of the battery.

The span control can either amplify or decrease the readings from the detector. Extreme caution must be taken when making any adjustments to the span control.

B. Limitations

If the IP of a compound is greater than energy of the UV light source, the HNU will not respond. Some compounds cannot be detected by any sensor or probe.

Condensation may form on the UV light source window resulting in erroneous readings. This may happen when going from an air conditioned environment to a hot and humid environment. Condensation may also occur in cold weather.

Humidity (up to 90% relative humidity) and pulsed DC or AC power lines, transformers and high voltage equipment may produce errors in readings.

The HNU will not detect methane.

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Meter readings indicate concentrations of gas that relative to the calibration gas concentration (usually benzene). Also, the instrument scale range is from 0 to 2,000 ppm and response to the calibration gas (benzene) is linear from 0 to 600 ppm. Above 600 ppm, the HNU may indicate a higher or lower concentration than the true value.

Wind speeds greater than three miles per hour and position of the probe relative to the wind direction, may affect the fan speed and meter readings.

The operating temperature of the HNU is 10 to 40 degrees Centigrade.

The response of the instrument may change when gases are mixed.

C. Safety

Do not look at the light source closer than six inches with unprotected eyes. If necessary, observe the light source for a brief time. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

This instrument is not intrinsically safe; therefore, it is a possible source of ignition in hazardous atmospheres. Recharge battery in a non-hazardous environment.

D. Equipment Composition

Not intrinsically safe.

E. Checklist

HNU
Charged Battery
Calibration Gas
Regulator
Tubing
Calibration Logbook
Shoulder Strap
Operating Manual
Check Source

F. Procedures

Startup Procedure

1. Check the FUNCTION switch on the control panel to make sure it is in the OFF position. Attach the probe to the readout unit. Match the alignment key, and twist the connector clockwise until a distinct locking is felt.

2. Turn the FUNCTION switch to the BATTERY CHECK position. Check that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged before using (or when using, discontinue use).
3. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15 to 20 seconds to confirm that the zero adjustment is stable. If it is not, then readjust.
4. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used (5.0 for 9.5 eV probe, 9.8 for 10.2 eV and 5.0 for 11.7 eV).
5. Set the FUNCTION switch to the desired ppm range. A violet glow from the UV lamp source should be observable at the sample inlet of the probe/sensor unit. To prevent eye damage, **DO NOT** look directly at the glow.
6. Listen for the fan operation to verify fan function.
7. Check instrument with an organic point source, such as a "magic marker," before survey to verify instrument function.

Shutdown Procedure

1. Turn FUNCTION switch to OFF.
2. Disconnect the probe connector.
3. Place the instrument on the charger. The recharge time necessary to bring a fully discharged battery to a full charge is 12 to 14 hours.

Calibration Procedure

For HNU calibration-canisters equipped with a regulator, the calibration procedure is as follows:

1. Run through startup procedures.
2. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNU.
3. Crack the regulator valve.
4. Take a reading after five to ten seconds.
5. Adjust the span potentiometer to produce the concentration listed on the span gas cylinder. This procedure shall be followed only until the span potentiometer reaches the following limits:

<u>Probe</u>	<u>Initial Span Pot. Setting</u>	<u>Max. Accept. Span Pot. Setting</u>
9.5 eV	5.0	1.0
10.2 eV	9.8	8.5
11.7 eV	-5.0	2.0

6. If these limits are exceeded, the instrument must be returned for maintenance and recalibration. This maintenance will be done only by qualified individuals.

G. Documentation

The following information must be recorded in the instrument calibration and test log and possibly in the site specific logbook for calibration.

1. Instrument name and model
2. ID or serial number
3. Date and time of calibration
4. Method of calibration
5. Results of calibration
6. Identification of calibration gas (source, type, concentration, lot number, span setting)
7. Name of calibrator

H. Cleaning the UV Light Source Window

1. Turn the FUNCTION switch to the OFF position, and disconnect the sensor/probe from the Readout/Control unit.
2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.
3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.
4. Tilt the lamp housing with one hand over the opening so that the lamp slides out of the housing into your hand.
5. The lamp window may now be cleaned using lens paper with any of the following compounds:
 - a. Use HNU cleaning compound on all lamps except the 11.7 eV.

- b. Clean the 11.7 eV lamp with a freon or chlorinated organic solvent. Do not use HNU cleaner, water or water miscible solvents, i.e. acetone or methanol.
6. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.
7. Place the end cap on top of the ion chamber, and replace the two screws. Tighten the screws only enough to seal the O-ring. Do not over tighten.
8. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assembly into the shell. It will fit only one way.
9. Replace the exhaust screw.

I. Cleaning the Ionization Chamber

1. Turn the FUNCTION switch to the OFF position, and disconnect the sensor/probe for the Readout/Control unit.
2. Remove the exhaust screws located near the base of the probes. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing for the shell.
3. Loosen the screws on the top of the end cap, and separate the end cap and ion chamber from the lamp and lamp housing, taking care that the lamp does not fall out of the lamp housing.
4. The ion chamber may now be cleaned according to the following sequence:
 - a. Clean with methanol using a Q-tip.
 - b. Dry gently at 50-60 degrees C for ½ hour.
5. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.
6. Place the end cap on top of the ion chamber, and replace the two screws. Tighten the screws only enough to seal the O-ring. Do not over tighten.
7. Line up the pins on the base of the lamp housing with pins inside the probe shell, and slide the housing assemble into the shell. It will fit only one way.

J. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use*
Initiate factory checkout and calibration	Yearly or when malfunctioning or after changing UV light source
Wipe down readout unit	After each use
Clean UV light source window	Every month or as used and as site conditions dictate
Clean the ionization chamber	Monthly
Recharge battery	After each use

* During extended field use, the HNU must be calibrated at least once every three days.

K. Troubleshooting

The following steps should be performed only by a qualified technician:

1. The meter does not respond in any switch position (including BATT CHK).
 - a. Meter movement is broken.
 - (1) Tip instrument rapidly from side to side. Meter needle should move freely and return to zero.
 - b. Electrical connection to meter is broken.
 - (1) Check all wires leading to meter.
 - (2) Clean the contacts of quick-disconnects.
 - c. Battery is completely dead.
 - (1) Disconnect battery.
 - (2) Check voltage with a volt-ohm meter.
 - d. Check 2 amp fuse.

- e. If none of the above solves the problem, consult the factory.
- 2. Meter responds in BATT CHK position, but reads zero or near zero for all others.
 - a. Power supply is defective.
 - (1) Check power supply voltages as shown in the HNU Instruction Manual. If any voltage is out of specification, consult the factory.
 - b. Input transistor or amplifier has failed.
 - (1) Rotate zero control. Meter should deflect up or down as control is turned.
 - (2) Open probe. Both transistors should be fully seated in sockets.
 - c. Input signal connection is broken in probe or readout
 - (1) Check input connector on printed circuit board. The input connector should be firmly pressed down.
 - (2) Check components on back of printed circuit board. All connections should be solid, and no wires should touch any other object.
 - (3) Check all wires in readout for solid connections.
- 3. Instrument responds correctly in BATT CHK and STBY but not in measuring mode.
 - a. Check to see that the light source is on. Do not look directly at UV light source.
 - (1) Check high-voltage power supply.
 - (2) Open end of probe, remove lamp and check high voltage on lamp ring.
 - (3) If high voltage is present at all above points, light source has probably failed. Consult the factory.

4. Instrument responds correctly in all positions, but signal is lower than expected.
 - a. Check span setting for correct value.
 - b. Clean window of light source.
 - c. Double check preparation of standards.
 - d. Check power supply 180 V output.
 - e. Check for proper fan operation. Check fan voltage.
 - f. Rotate span setting. Response should change if span potentiometer is working properly.
5. Instrument responds in all switch positions, but is noisy (erratic meter movement).
 - a. Open circuit in feedback circuit. Consult the factory.
 - b. Open circuit in cable shield or probe shield. Consult the factory.
6. Instrument response is slow and/or not reproducible.
 - a. Fan is operating improperly. Check fan voltage.
 - b. Check calibration and operation.
7. The battery indicator is low.
 - a. Indicator comes on if battery charge is low.
 - b. Indicator also comes on if ionization voltage is too high.

MicroTIP-MP100
Photoionization Detector

FSOP: 13.03
Date: April 1, 1997
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A. Application

Action levels to determine appropriate level of protection must be set before using MicroTIP-MP100 in the field. Use FSOP 1.01, Initial Site Entry, to set action levels.

MicroTIP-MP100 measures the concentration of airborne ionizable gases and vapors, which are automatically displayed and recorded. The displayed reading represents the total concentration of ionizable chemicals present. The MicroTIP-MP100 is a photoionizing detector with a standard ultraviolet lamp having an energy of 10.6 +/- 0.1 eV. An 11.7 eV lamp is also available. The ionization potential (IP) of the compound being detected must be less than the electron volt energy of the light source. As the IP approaches the eV energy of the light source more energy is needed and therefore less of the compound is detected.

The Minimum, Maximum, and Average concentrations measured in each 15-second period are automatically recorded in MicroTIP-MP100's datalogging memory. Concentration data can be retrieved back from the memory to the display or sent to a printer or computer in either a tabular or a graphical format.

A fully charged battery will provide up to 6 hours of use. Leaving the MicroTIP-MP100 for more than three days, without a charged battery pack will result in loss of recorded data and setup parameters.

B. Limitations

Since MicroTIP-MP100 detects the total concentration of all ionizables present, it cannot distribution between different compounds. Even if the MicroTIP-MP100 is calibrated to a specific compound, any other ionizable compounds present will influence MicroTIP-MP100's readings, because its response is not compound specific.

If the IP of a compound is greater than the energy of a UV light source, the MicroTIP-MP100 will not respond to that compound. Some compounds cannot be detected by any sensor or probe. Compared to the 10.6 eV lamp, the 11.7 eV lamp can detect a wider range of compounds; however, its lifetime is considerably shorter.

Permanent damage can be caused if liquid is drawn into the MicroTIP-MP100.

C. Safety

Do not look directly into the light source.

Recharge battery in a nonhazardous environment.

The MicroTIP-MP100 does not carry an Intrinsic Safety Rating and must not be operated in a hazardous location in which combustible mixtures may be present.

Follow manufacturer's recommendation for safe use of this product.

D. Equipment Composition

Instrument is not intrinsically safe.

E. Checklist

MicroTIP-MP100 (including probe)
Calibration gas, gas bag, and regulator
Shoulder Strap
Headset and Earphones for optional audio connection
Printer Cable Electrical Connection
Calibration Log Book
Operating Manual
Replacement Filters

F. Set-up Procedures

1. Turn POWER on. When the display changes from "WARMING UP NOW, PLEASE WAIT..." to "READY" with event number, time, date, and ppm reading; the MicroTIP-MP100 is on.
2. Press the SETUP key on the key pad.
3. Use the up (↑) and down (↓) arrow keys to select the 20, 200, or 2000 parts per million (ppm) range. Press ENTER.
4. Select one of the five Cal Memories by using the up (↑) and down (↓) arrow keys. Press ENTER. Note; only one Cal Memory can be used at a time.
5. Enter the values for the current time. Press ENTER after each value.
6. Enter the numerical values for the day, month, and year. Press ENTER after each selection.

G. Calibration Procedure

a.) Preparing the Span Gases Sample Bags

1. Connect the supplied regulator to the Span Gas Cylinder, 100 ppm Isobutylene is recommended. Hand tighten the fittings.
2. Open the valve on the gas bag by turning the valve stem fully counter clockwise.
3. Attach the gas bag adaptor nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adaptor and empty it. Flush the bag a 2 or 3 times with the Span Gas and then fill it.
7. Close the gas bag by turning the valve clockwise.

b.) Meter Calibration

1. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER. Press EXIT to leave Setup.
2. Press CAL and expose MicroTIP-MP100 to zero Gas, or Ambient Air. Press ENTER and MicroTIP-MP100 sets its zero point.
3. MicroTIP-MP100 then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adaptor to the inlet.
4. Press ENTER and MicroTIP-MP100 sets its sensitivity.
5. When MicroTIP-MP100's display reverts to normal display, it is calibrated. Remove the span gas from the inlet.

c.) Calibration of Other Four Memories

1. Press SETUP and select the desired Cal Memory (1 to 5) with the arrow keys.
2. Exit from Setup and press the CAL key.
3. Follow the displayed calibration instructions under sections (a and b) above.

H. Documentation

The following information must be recorded in the instrument calibration and test log.

1. Instrument name and model.
2. I.D. or serial number.
3. Date and time of calibration.
4. Method of calibration.
5. Results of calibration.
6. Identification of calibration gas (source, type, concentration, lot number).
7. Name of calibrator.

I. Routine Maintenance

a.) Charging the Battery

1. When the instrument status reads LoBat, the MicroTIP-MP100 battery pack requires recharging, although the MP100 can be recharged before LoBat appears.
2. Disconnect the battery pack from the MicroTIP-MP100 unit by pressing the release button on the bottom of the MicroTIP-MP100 and removing the battery pack by sliding it backwards.
3. Inspect the battery leads for dirt and/or corrosion.
4. Set the voltage selector switch on the bottom of the battery charger to the appropriate AC line voltage.
5. First plug the charger into the battery pack, then plug the charger into the outlet and allow the battery pack to charge for at least 8 hours.
6. After charging remove the charger, first from the wall outlet then from the battery pack, and slide the battery pack onto MicroTIP-MP100.

b.) Cleaning the Lamp Window

1. Turn Power off. Unscrew the black detector cover and unplug red and yellow wires for UHF driver circuit board. **NOTE: Care should be taken when performing this task.**
2. Grasp lamp holder and unscrew detector cell from lamp holder with red and yellow wires still attached. Be careful not to loosen the o-ring seal on top of the photoionization detector.
3. Remove lamp from holder, leaving spring in lamp holder.

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4. To remove film, rub lamp window with a methanol moistened tissue.
5. Using a clean lint-free tissue, dry lamp window.
6. Replace lamp into lamp holder without touching window.
7. Install detector cell onto lamp holder and tighten just until snug.
8. Re-connect yellow wire onto gold pin and red wire onto tinned pin on UHF driver circuit board.
9. Hand tighten detector cover.

c.) Replacing the Dust Filter

1. Turn Power Off.
2. Hold filter housing near detector cap with 9/16" wrench, then unscrew top of housing with another 9/16" wrench.
3. Remove spring and filter.
4. Install new filter. Slip spring into top of housing and assemble housing. Tighten with two wrenches.

J. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use
Initiate factory checkouts and calibration	Yearly or when malfunctioning
Clean the window	Clean lamp window every 24hrs. of operation
Replace dust filter	Every 240hrs. of operation or more frequently if meter is used in a dusty environment
Recharge battery	When the instrument status reads LoBat

K. Troubleshooting

a.) If MicroTIP-MP100 Draws in Liquid

Follow maintenance instructions in Chapter 5 "Troubleshooting" in manual.

b.) Instrument Status and Fault Displays

1. The instrument status appears at the left of the upper line on the display and on the print and graph outputs.
2. If more than one status is in effect, then the status with the highest priority is displayed. The status will continue until the condition is corrected or until the option is turned off.

c.) Table Summary of MicroTIP-MP100 Status

Status	Code	Priority	Description
Fault	F	1	One of 3 faults is occurring. Press TUTOR for details.
Over	O	2	Detected concentration exceeds 9999 on the display.
Alarm	A	3	Detected concentration exceeds set alarm level.
Cal	C	4	Will never be observed on the display during normal operation as various calibration prompt messages are displayed while the meter is calibrating.
LoBat	L	5	Battery pack is low. Recharge or replace pack.
Play	P	6	The instrument is playing back previously recorded data.
Hi Sens	H	7	High Sensitivity operation.
Ready	R	8	Normal Operation.

d.) Fault Summaries

<u>Fault Description</u>	<u>Probable Causes</u>	<u>Corrective Action</u>
Detector light intensity is low.	Defective detector UV lamp.	Replace the lamp.
	Poor connection between lamp holder and HF driver circuit board.	Check the wire joining the lamp holder to the HF drive circuit board. (See manual Section 4.2)
Signal from zero gas is too high.	Contamination of sample line or fittings.	Clean or replace line. Replace inlet filter.
	Span and Zero gas mixed up.	Ensure clean gas is used to zero meter.
Detector field voltage is low.	Contamination in detector.	Contact RRS Equipment and Purchasing Coordinator.
	Short circuit in detector.	See Manual
	Internal fault in electronics.	Contact Photo-Vac Service

L. Miscellaneous

a.) Audio Connection Procedures

1. To connect the headset, remove the dustcover from the I/O connector and plug in the headset.
2. Press the AUDIO key on the key pad.
3. Use the up () and down () arrow keys to select one of the three options for audio output and press ENTER.

4. Adjust the audio volume by the knob on the headset.

b.) Alarm Activation Procedures

1. Press the ALARM key on the key pad.
2. The current alarm setting is displayed. To change the alarm level value enter the new level and press ENTER. To use the current value wait for the display to revert to normal in 15 seconds or press the EXIT key.

c.) Data Play Back Procedure

1. Press the PLAY key on the key pad. Two options are available. Pressing ENTER begins playback where it was last stopped. Press the SETUP key to set the playback options.
2. Select the start Event.
3. Select which value is to be displayed, either the Minimum, the Average, or the Maximum, with the arrow keys and press the ENTER key.
4. The data can be played back in either numerical or graphical display by pressing the DISPLAY key.

NOTE: To view the playback data in opposite directions use the forward arrow (>) to display data forward or backward arrow (<) to display data backward.

NOTE: Press ENTER to freeze to display at any time and the arrow keys to resume playback. Press EXIT to return to normal display.

d.) Printer loading (See manual)

e.) Graphical Down Loading (See manual)

f.) High Sensitivity Operation:

1. Press SETUP. Select the 0-20 ppm display range with the arrow keys and press ENTER.
2. Select High Sensitivity with the arrow keys and press ENTER.
3. Press EXIT and then select the bar graph with the DISPLAY key.

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4. Press CAL and calibrate MicroTIP-MP100 with zero gas. High sensitivity operations does not require span gas.
5. Press Audio and select "Continuous Audio" with the arrow keys if head phone use is desired.

g.) Establishing Computer Communications

1. Ensure MicroTIP-MP100 is connected to the serial port of the computer.
2. Ensure the cable being used is compatible with the device.
3. Ensure all hardware is working properly.

MicroTIP HL-2000
Photoionization Detector

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A. Application

Action levels to determine appropriate level of personal protection must be set before using MicroTIP HL-2000 in the field. Use FSOP 1.01, Initial Site Entry, to set action levels.

MicroTIP HL-2000 measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. The MicroTIP HL-2000 is a photoionizing detector with a standard ultraviolet lamp having an energy of 10.6 +/- 0.1 eV. There are 9.5 and 11.7 eV lamps also available. The ionization potential (IP) of the compound being detected must be less than the electron volt energy of the light source. As the IP approaches the eV energy of the light source more energy is needed and therefore less of the compound is detected.

The Minimum, Maximum, and Average concentrations measured in each 15-second period are automatically recorded in MicroTIP HL-2000's datalogging memory. Concentration data can be retrieved back from the memory to the display or sent to a printer or computer in either a tabular or a graphical format.

A fully charged battery will provide up to 6 hours of use. Leaving the MicroTIP HL-2000 for more than three days, without a charged battery pack will result in loss of recorded data and setup parameters.

B. Limitations

Since MicroTIP HL-2000 detects the total concentration of all ionizable present, it cannot distinguish between different compounds. Even if the MicroTIP HL-2000 is calibrated to a specific compound, any other ionizable compounds present will influence MicroTIP HL-2000's readings, because its response is not compound specific. Other compounds will elicit a response relative to the calibration compound.

If the IP of a compound is greater than the energy of a UV light source, the MicroTIP HL-2000 will not respond to that compound. Some compounds cannot be detected by any sensor or probe. Although the 11.7 eV lamp can detect a wider range of compounds, its lifetime is considerably shorter.

Permanent damage can be caused if liquid is drawn into the MicroTIP HL-2000.

C. Safety

Do not look directly at the light source.
Recharge battery in a nonhazardous environment.
The MicroTIP HL-2000 does not carry an Intrinsic Safety Rating and must not be operated in a hazardous location in which combustible mixtures may be present.

D. Equipment Composition

Instrument is not intrinsically safe.

E. Checklist

MicroTIP HL-2000 (Including Probe)
Calibration gas, gas bag, and regulator
Shoulder Strap
Headset and Earphones
Printer Cable Electrical Connection
Calibration Log Book
Tools
Operating Manual
Replacement Filters

F. Set-up Procedures

1. Turn POWER on. When the display changes from "WARMING UP NOW, PLEASE WAIT..." to "READY" with event number, time, date, and ppm reading; the MicroTIP HL-2000 is now on.
2. Press the SETUP key on the key pad.
3. Use the up () and down () arrow keys to select the 20, 200, or 2000 parts per million (ppm) range. Press ENTER.
4. Select one of the five Cal Memories by using the up () and down () arrow keys. Press ENTER. Note; only one Cal Memory can be used at a time.
5. Enter the values for the current time. Press ENTER after each value.
6. Enter the numerical values for the day, month, and year. Press ENTER after each selection.

G. Calibration Procedure

- a) Preparing the Span Gases Sample Bags.
 1. Connect the supplied regulator to the Span Gas Cylinder, 100 ppm Isobutylene is recommended. Hand tighten the fittings.
 2. Open the valve on the gas bag by turning the valve stem fully counter clockwise.

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3. Attach the gas bag adaptor nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adaptor and empty it. Flush the bag a few times with the Span Gas and then fill it.
7. Close the gas bag by turning the valve clockwise.

b) **Meter Calibration**

1. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER. Press EXIT to leave Setup.
2. Press CAL and expose MicroTIP HL-2000 to zero Gas, or Ambient Air. Press ENTER and MicroTIP HL-2000 sets its zero point.
3. MicroTIP HL-2000 then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adaptor to the inlet.
4. Press ENTER and MicroTIP HL-2000 sets its sensitivity.
5. When MicroTIP HL-2000 display reverts to normal display, it is calibrated. Remove the span gas from the inlet.

c) **Calibration of Other Four Memories**

1. Press SETUP and select the desired Cal Memory (1 to 5) with the arrow keys.
2. Exit from Setup and press the CAL key.
3. Follow the displayed calibration instructions under sections (a and b) above.

H. **Documentation**

The following information must be recorded in the instrument calibration and test log.

1. Instrument name and model.
2. I.D. or serial number.
3. Date and time of calibration.
4. Battery Check results.
5. Method of calibration.

6. Results of calibration.
7. Identification of calibration gas (source, type, concentration, lot number).
8. Signature of calibrator.

I. Routine Maintenance

a) Charging the Battery

1. When the instrument status reads LoBat, the MicroTIP HL-2000 battery pack requires recharging, although the HL-2000 can be recharged before LoBat appears.
2. Disconnect the battery pack from the MicroTIP HL-2000 unit by pressing the release button on the bottom of the MicroTIP HL-2000 and removing the battery pack by sliding it backwards.
3. Inspect the battery leads for dirt and/or corrosion.
4. Set the voltage selector switch on the bottom of the battery charger to the appropriate AC line voltage.
5. First plug the charger into the battery pack, then plug the charger into the outlet and allow the battery pack to charge for at least 8 hours.
6. After charging remove the charger, first from the wall outlet then from the battery pack, and slide the battery pack onto the MicroTIP HL-2000.

b) Cleaning the Lamp Window

1. Turn Power Off. Unscrew the black detector cover and disconnect red and yellow wires for UHF driver circuit board.
2. Grasp lamp holder and unscrew detector cell from lamp holder with red and yellow wires still attached. Be careful not to lose the o-ring seal on top of the photoionization detector.
3. Remove lamp from holder, leaving spring in lamp holder.
4. To remove film, rub lamp window with a methanol moistened tissue.
5. Using a clean lint-free tissue, dry lamp window.
6. Replace lamp into lamp holder without touching window.

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7. Install detector cell onto lamp holder and tighten just until snug.
 8. Plug yellow wire onto gold pin and red wire onto tinned pin on UHF driver circuit board.
 9. Hand tighten detector cover.
- c) Replacing the Dust Filter
1. Turn Power Off.
 2. Hold filter housing near detector cap with 9/16" wrench, then unscrew top of housing with another 9/16" wrench.
 3. Remove spring and filter.
 4. Install new filter. Slip spring into top of housing and assemble housing. Tighten with tow wrenches.

J. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use
Initiate factory checkouts and calibration	Yearly or when malfunctioning
Clean the window	Clean lamp window every 24hrs. of operation
Replace dust filter	Every 240hrs. of operation or more frequently if meter is used in a dusty environment
Recharge battery	When the instrument status reads LoBat

K. Troubleshooting

- a) If MicroTIP HL-2000 Draws in Liquid
- Follow maintenance instructions in Chapter 5 "Troubleshooting" in manual.

b) Instrument Status and Fault Displays

1. The instrument status appears at the left of the upper line on the display and on the print and graph outputs.
2. If more than one status is in effect, then the status with the highest priority is displayed. The status will continue until the condition is corrected or until the option is turned off.

c) Table Summary of MicroTIP HL-2000 Status.

<u>Status</u>	<u>Code</u>	<u>Priority</u>	<u>Description</u>
Fault	F	1	One of 3 faults is occurring. Press TUTOR for details.
Over	O	2	Detected concentration exceeds 9999 on the display.
Alarm	A	3	Detected concentration exceeds the set alarm level.
Cal	C	4	Will never be observed on the display during normal operation as various calibration prompt messages are displayed while the meter is calibrating.
LoBat	L	5	Battery pack is low. Recharge or replace pack.
Play	P	6	The instrument is playing back previously recorded data.
Hi Sens	H	7	High Sensitivity Operation
Ready	R	8	Normal Operation

d) Fault Summaries

<u>Fault Description</u>	<u>Probable Causes</u>	<u>Corrective Action</u>
Detector light intensity is low.	Defective detector UV lamp.	Replace the lamp.
	Poor connection between lamp holder and HF driver circuit board.	Check the wire joining the lamp holder to the HF drive circuit board. (See manual Section 4.2)
Signal from zero gas is too high.	Contamination of sample line or fittings.	Clean or replace line. Replace inlet filter.
	Span and Zero gas mixed up.	Ensure clean gas is used to zero meter.
Detector field voltage is low.	Contamination in detector.	Contact DERR Equipment and purchasing coordinator.
	Short circuit in detector.	See manual.
	Internal fault in electronics.	Contact Photo-Vac Service PhotoVac Service 516-254-4283

L. Miscellaneous

a. Audio Connection Procedures

1. To connect the headset, remove the dustcover from the I/O connector and plug in the headset.
2. Press the AUDIO key on the key pad.

3. Use the up () and down () arrow keys to select one of the three options for audio output and press ENTER.
 4. Adjust the audio volume by the knob on the headset.
- b. Alarm Activation Procedures
1. Press the ALARM key on the key pad.
 2. The current alarm setting is displayed. To change the alarm level value enter the new level and press ENTER. To use the current value wait for the display to revert to normal in 15 seconds or press the EXIT key.
- c. Data Play Back Procedure
1. Press the PLAY key on the key pad. Two options are available. Pressing ENTER begins playback where it was last stopped. Press the SETUP key to set the playback options.
 2. Select the start Event.
 3. Select which value is to be displayed, either the Minimum, the Average, or the Maximum, with the arrow keys and press the ENTER key.
 4. The data can be played back in either numerical or graphical display by pressing the DISPLAY key.
- NOTE: To view the playback data in opposite directions use the forward arrow (>) to display data forward or a backward arrow (<) to display data backward.
- NOTE: Press ENTER to freeze the display at any time and the arrow keys to resume playback. Press EXIT to return to normal display.
- d. Printer Down Loading (See manual)
- e. Graphical Down Loading (See manual)
- f. High Sensitivity Operation
1. Press SETUP. Select the 0-20 ppm display range with the arrow keys and press ENTER.
 2. Select High Sensitivity with the arrow keys and press ENTER.

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3. Press EXIT and then select the bar graph with the DISPLAY key.
 4. Press CAL and calibrate MicroTIP HL-2000 with zero gas. High sensitivity operations does not require span gas.
 5. Press Audio and select "Continuous Audio" with the arrow keys if head phone use is desired.
- g. Establishing Computer Communications
1. Ensure MicroTIP HL-2000 is connected to the serial port of the computer.
 2. Ensure the cable being used is compatible with the device.
 3. Ensure all hardware is working properly.

MicroTIP IS-3000
Photoionization Detector

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Date: April 1, 1997
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Approved By: _____
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A. Application

Action levels to determine appropriate level of personal protection must be set before using MicroTIP IS-3000 in the field. Use FSOP 1.01, Initial Site Entry, to set action levels.

MicroTIP IS-3000 measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. The MicroTIP IS-3000 is a photoionizing detector with a standard ultraviolet lamp having an energy of 10.6 +/- 0.1 eV. There are 9.5 and 11.7 eV lamps also available. The ionization potential (IP) of the compound being detected must be less than the electron volt energy of the light source. As the IP approaches the eV energy of the light source more energy is needed and therefore less of the compound is detected.

The Minimum, Maximum, and Average concentrations measured in each 15-second period are automatically recorded in MicroTIP IS-3000's data logging memory. MicroTIP's memory holds up to twelve hours of concentration data. This data can be retrieved back from the memory to the display or sent to a printer or computer in either a tabular or a graphical format.

A fully charged battery will provide up to 6 hours of use. Leaving the MicroTIP IS-3000 for more than three days, without a charged battery pack will result in loss of recorded data and setup parameters.

B. Limitations

Since MicroTIP IS-3000 detects the total concentration of all ionizables present, it cannot distinguish between different compounds. Even if the MicroTIP IS-3000 is calibrated to a specific compound, any other ionizable compounds present will influence MicroTIP IS-3000's readings, because its response is not compound specific.

If the IP of a compound is greater than the energy of a UV light source, the MicroTIP IS-3000 will not respond to that compound. Some compounds cannot be detected by any sensor or probe. Although the 11.7 eV lamp can detect a wider range of compounds, its lifetime is considerably shorter.

Permanent damage can be caused if liquid is drawn into the MicroTIP IS-3000.

C. Safety

Do not look directly at the light source.

Recharge battery in a nonhazardous environment.

The MicroTIP IS-3000 carries an Intrinsic Safety Rating and can be operated in a hazardous location in which combustible mixtures may be present.

Follow manufacturer's recommendations for safe use of this product.

D. Equipment Composition

Instrument is intrinsically safe.

E. Checklist

MicroTIP IS-3000 (Including Probe)
Calibration gas, gas bag, and regulator
Shoulder Strap
Headset and Earphones for optional audio connection
Printer Cable Electrical Connection
Calibration Log Book
Tools
Operating Manual
Replacement Filters

F. Set-up Procedures

1. Turn POWER on. When the display changes from "WARMING UP NOW, PLEASE WAIT..." to "READY" with event number, time, date, and ppm reading; the MicroTIP IS-3000 is now on.
2. Press the SETUP key on the key pad.
3. Use the up (↑) and down (↓) arrow keys to select the 20, 200, or 2000 parts per million (ppm) range. Press ENTER.
4. Select one of the five Cal Memories by using the up (↑) and down (↓) arrow keys. Press ENTER. Note; only one Cal Memory can be used at a time.
5. Enter the values for the current time. Press ENTER after each value.
6. Enter the numerical values for the day, month, and year. Press ENTER after each selection.

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G. Calibration Procedure

a) Preparing the Span Gases Sample Bags.

1. Connect the supplied regulator to the Span Gas Cylinder, 100 ppm Isobutylene is recommended. Hand tighten the fittings.
2. Open the valve on the gas bag by turning the valve stem fully counter clockwise.
3. Attach the gas bag adaptor nut to the regulator. Hand tighten the fittings.
4. Turn the regulator knob counterclockwise about half a turn to start the flow of gas.
5. Fill the gas bag about half full and then close the regulator fully clockwise to turn off the flow of gas.
6. Disconnect the bag from the adaptor and empty it. Flush the bag 2 or 3 times with the Span Gas and then fill it.
7. Close the gas bag by turning the valve clockwise.

b) Meter Calibration

1. Press SETUP and select the desired Cal Memory with the arrow keys and press ENTER. Press EXIT to leave Setup.
2. Press CAL and expose MicroTIP IS-3000 to zero Gas, or Ambient Air. Press ENTER and MicroTIP IS-3000 sets its zero point.
3. MicroTIP IS-3000 then asks for the span gas concentration. Enter the known span gas concentration and then connect the span gas bag adaptor to the inlet.
4. Press ENTER and MicroTIP IS-3000 sets its sensitivity.
5. When MicroTIP IS-3000 display reverts to normal display, it is calibrated. Remove the span gas from the inlet.

c) Calibration of Other Four Memories

1. Press SETUP and select the desired Cal Memory (1 to 5) with the arrow keys.
2. Exit from Setup and press the CAL key.
3. Follow the displayed calibration instructions under sections (a and b) above.

H. Documentation

The following information must be recorded in the instrument calibration and test log.

1. Instrument name and model.
2. I.D. or serial number.
3. Date and time of calibration.
4. Battery Check results.
5. Method of calibration.
6. Results of calibration.
7. Identification of calibration gas (source, type, concentration, lot number).
8. Signature of calibrator.

I. Routine Maintenance

a) Charging the Battery

1. When the instrument status reads LoBat, the MicroTIP IS-3000 battery pack requires recharging, although the IS-3000 can be recharged before LoBat appears.
2. Disconnect the battery pack from the MicroTIP IS-3000 unit by pressing the release button on the bottom of the MicroTIP IS-3000 and removing the battery pack by sliding it backwards.
3. Inspect the battery leads for dirt and/or corrosion.
4. Set the voltage selector switch on the bottom of the battery charger to the appropriate AC line voltage.
5. First plug the charger into the battery pack, then plug the charger into the outlet and allow the battery pack to charge for at least 8 hours.

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6. After charging remove the charger, first from the wall outlet then from the battery pack, and slide the battery pack onto the MicroTIP IS-3000.

b) Cleaning the Lamp Window

NOTE: Care should be taken when performing this task.

1. Turn Power Off. Unscrew the black detector cover and disconnect red and yellow wires for UHF driver circuit board.
2. Grasp lamp holder and unscrew detector cell from lamp holder with red and yellow wires still attached. Be careful not to lose the o-ring seal on top of the photoionization detector.
3. Remove lamp from holder, leaving spring in lamp holder.
4. To remove film, rub lamp window with a methanol moistened tissue.
5. Using a clean lint-free tissue, dry lamp window.
6. Replace lamp into lamp holder without touching window.
7. Install detector cell onto lamp holder and tighten just until snug.
8. Re-connect yellow wire onto gold pin and red wire onto tinned pin on UHF driver circuit board.
9. Hand tighten detector cover.

c) Replacing the Dust Filter

1. Turn Power Off.
2. Hold filter housing near detector cap with 9/16" wrench, then unscrew top of housing with another 9/16" wrench.
3. Remove spring and filter.
4. Install new filter. Slip spring into top of housing and assemble housing. Tighten with tow wrenches.

J. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use
Initiate factory checkout and calibration	Yearly or when malfunctioning
Clean the window	Clean lamp window every 24 hrs. of operation
Replace dust filter	Every 240 hrs. of operation or more frequently if meter is used in a dusty environment
Recharge battery	When the instrument status reads LoBat

K. Troubleshooting

- a) If MicroTIP IS-3000 Draws in Liquid

Follow maintenance instructions in Chapter 5 "Troubleshooting" in manual.
- b) Instrument Status and Fault Displays
 - 1. The instrument status appears at the left of the upper line on the display and on the print and graph outputs.
 - 2. If more than one status is in effect, then the status with the highest priority is displayed. The status will continue until the condition is corrected or until the option is turned off.

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c) Table Summary of MicroTIP IS-3000 Status.

<u>Status</u>	<u>Code</u>	<u>Priority</u>	<u>Description</u>
Fault	F	1	One of 3 faults is occurring. Press TUTOR for details.
Over	O	2	Detected concentration exceeds 9999 on the display.
Alarm	A	3	Detected concentration exceeds the set alarm level.
Cal	C	4	Will never be observed on the display during normal operation as various calibration prompt messages are displayed while the meter is calibrating.
LoBat	L	5	Battery pack is low. Recharge or replace pack.
Play	P	6	The instrument is playing back previously recorded data.
Hi Sens	H	7	High Sensitivity Operation
Ready	R	8	Normal Operation

d) Fault Summaries

<u>Fault Description</u>	<u>Probable Causes</u>	<u>Corrective Action</u>
Detector light intensity is low.	Defective detector UV lamp.	Replace the lamp.
	Poor connection between lamp holder and HF driver circuit board.	Check the wire joining the lamp holder to the HF drive circuit board. (See manual Section 4.2)

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<u>Fault Description</u>	<u>Probable Causes</u>	<u>Corrective Action</u>
Signal from zero gas is too high.	Contamination of sample line or fittings.	Clean or replace line. Replace inlet filter.
	Span and Zero gas mixed up.	Ensure clean gas is used to zero meter.
Detector field voltage is low.	Contamination in detector.	Contact DERR Equipment and purchasing coordinator.
	Short circuit in detector.	See manual.
	Internal fault in electronics.	Contact Photo- Vac Service PhotoVac Service 516-254-4283

I. Miscellaneous

a. Audio Connection Procedures

1. To connect the headset, remove the dust cover from the I/O connector and plug in the headset.
2. Press the AUDIO key on the key pad.
3. Use the up () and down () arrow keys to select one of the three options for audio output and press ENTER.
4. Adjust the audio volume by the knob on the headset.

b. Alarm Activation Procedures

1. Press the ALARM key on the key pad.
2. The current alarm setting is displayed. To change the alarm level value enter the new level and press ENTER. To use the current value wait for the display to revert to normal in 15 seconds or press the EXIT key.

c. Data Play Back Procedure

1. Press the PLAY key on the key pad. Two options are available. Pressing ENTER begins playback where it was last stopped. Press the SETUP key to set the playback options.
2. Select the start Event.
3. Select which value is to be displayed, either the Minimum, the Average, or the Maximum, with the arrow keys and press the ENTER key.
4. The data can be played back in either numerical or graphical display by pressing the DISPLAY key.

NOTE: To view the playback data in opposite directions use the forward arrow (>) to display data forward or a backward arrow (<) to display data backward.

NOTE: Press ENTER to freeze the display at any time and the arrow keys to resume playback. Press EXIT to return to normal display.

d. Printer Down Loading (See manual)

e. Graphical Down Loading (See manual)

f. High Sensitivity Operation

1. Press SETUP. Select the 0-20 ppm display range with the arrow keys and press ENTER.
2. Select High Sensitivity with the arrow keys and press ENTER.
3. Press EXIT and then select the bar graph with the DISPLAY key.
4. Press CAL and calibrate MicroTIP IS-3000 with zero gas. High sensitivity operations does not require span gas.
5. Press Audio and select "Continuous Audio" with the arrow keys if head phone use is desired.

g. Establishing Computer Communications

1. Ensure MicroTIP IS-3000 is connected to the serial port of the computer.
2. Ensure the cable being used is compatible with the device.
3. Ensure all hardware is working properly.

MSA Passport
Photoionization Detector

FSOP: 13.06
Date: April 1, 1997
Revision #:
Approved By:
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A. Application

Action levels to determine appropriate level of personal protection must be set before using the Passport PID in the field. Use FSOP 1.01, Initial Site Entry, to set action levels.

The Passport PID measures the concentration of airborne photoionizable gases and vapors and automatically displays and records these concentrations. The Passport PID is a photoionizing detector with a standard ultraviolet lamp having an energy of 10.6 +/- 0.1 eV. The ionization potential (IP) of the compound being detected must be less than the electron volt energy of the light source. As the IP approaches the eV energy of the light source, more energy is needed and therefore less of the compound is detected.

B. Limitations

The Passport PID Monitor should be used to detect only photoionizable gases. Toxic chemicals that cannot be ionized by the detector may be present; the Passport PID Monitor is not intended to detect these chemicals.

Moisture, oxygen and methane will quench the PID signal causing the instrument to under report concentration readings.

When sampling with accessory sampling lines, the shortest possible length should be used to minimize the time needed to obtain a valid reading.

If liquids enter the instrument, internal damage may result. The presence of liquid in the sample line may obstruct the flow of sample gas, causing the unit to generate inaccurate readings.

C. Safety

Recharge battery in a nonhazardous environment.

Daily calibration checks are part of the routine setup procedure for this instrument. Failure to recalibrate when necessary can adversely affect the accuracy of concentration readings.

Use only MSA replacement parts to avoid damaging the instrument and voiding the warranty.

Do not connect the sample inlet port to a pressurized gas line as this will damage the internal pump.

100 feet of 1/8" tubing represents the maximum flow restriction that the internal sample pump can endure. Using a longer or smaller diameter line could overload the internal pump and damage it.

The battery pack must be disconnected from the unit before shipping. They can be shipped together however.

D. Equipment Composition

Instrument is intrinsically safe.

E. Checklist

Passport PID Monitor with installed 10.6 eV lamp
Sample probe handle
Sample probe wand
10 foot sampling line
Ni-Cd C Cell battery charger
Two fittings for alternative sampling methods
Sample filters
Earphone
Replacement particulate filters for sample probe
User's Manual
Instruction Card

F. Set-up Procedures

1. Press ON/OFF to turn on the monitor. After the diagnostic message "MEASURE PLEASE WAIT" the Fresh Air Setup page opens automatically.
2. Press RESET (YES) to perform a fresh air setup. Fresh air setup is initiated. When the fresh air setup is completed the Exposure page opens automatically.

*Note: If an ERROR prompt appears during fresh air setup, contact an MSA authorized Service Technician. Do not use the instrument for protection.

3. Press NO(PAGE) to bypass the fresh air setup. The Exposure page opens.

G. Calibration Procedure

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a) Preparing the Span Gases Sample Bags.

1. Be sure you are in a fresh air environment. Press ON/OFF to turn on the monitor.
2. When the exposure page opens, read the concentration displayed on the Passport PID Monitor. If the displayed concentration is greater than zero, perform a Fresh Air Setup.
3. Attach the regulator to the calibration tubing.
4. When the displayed concentration reads zero ppm, attach the regulator to the span gas bottle.
5. Attach the calibration tubing to the sample inlet port on the monitor.
6. Open the valve on the regulator. Allow calibration gas to flow into the instrument for at least two minutes. Note the concentration reported by the monitor. The displayed concentration should be within 5% of the concentration stated on the span gas bottle.

If the span gas does not read accurately, the Passport PID Monitor must be calibrated before use.

H. Documentation

The following information must be recorded in the instrument calibration and test log.

1. Instrument name and model.
2. I.D. or serial number.
3. Date and time of calibration.
4. Battery Check results.
5. Method of calibration.
6. Results of calibration.
7. Identification of calibration gas (source, type, concentration, lot number).
8. Signature of calibrator.

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I. Routine Maintenance

a) Charging the Battery

1. When the battery status reads low, then the battery needs recharged.
2. It is not necessary to remove the battery pack from the monitor, turn off the instrument.
3. If the battery pack is attached to the monitor, turn off the instrument.
4. Insert any MSA Omega charger plug into the jack on the battery pack.
5. Be sure the red operating light is on. If the operating light is not on, the battery pack is not being charged.
6. Allow the battery pack to charge undisturbed overnight. When fully charged, the standard Type A, Ni-Cd battery pack will power the Passport PID for six hours of continuous use at 25 C.

b) Cleaning the Lamp Window

1. Turn Power Off. Unscrew and remove the lamp cap from the back of the detector housing.
2. Grasp the white lamp handle and slide the lamp from the housing. Do not touch the lamp lens with your hands.
3. Remove and discard lamp o-ring.
4. Open the PID polishing kit. Shake the vial of polishing compound to mix. Moisten a clean cotton swab with the compound. Using a circular motion, polish the lamp lens for one minute. If necessary, apply more polishing compound to the lens with a clean swab.
5. Using the felt pad provided, wipe the dried residue from the lamp lens. Inspect the lens. Remove any residue caught in o-ring seat or around the lens with a clean tooth pick.
6. If clean, dry, pressurized air is available, remove any dried particles by spraying the lens and lamp with air.

Note: Do not use air from an air compressor. Compressed air is not oil-free and could contaminate the lens surface. Likewise, do not blow on the lens to remove particles.

7. Place a new o-ring on the lamp and install the lamp into the monitor. Never touch the surface of the lens with your fingers. If accidental contact occurs, repeat the cleaning procedure.
8. If a flow meter is available, perform the optional leak test. After cleaning the lamp and testing for leaks, be sure to calibrate the instrument before use.

c. Leak Test (Optional)

1. Turn the instrument on, and detach the sample probe. Attach a flow meter to the sample outlet port.
2. Measure and note the amount of flow from the outlet port.
3. Seal off the sample inlet port by pressing a piece of closed cellfoam or non-porous laboratory film firmly over the port.
4. Monitor the flow detected from the outlet port. It should read zero, plus or minus the accuracy of the flow meter, if positive flow is detected from the outlet port when the inlet is securely sealed, there is a leak in the system. If a leak is detected, remove the o-ring and clean the o-ring seat. Place a new o-ring on the lamp and retest.

J. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use
Initiate factory checkouts and calibration	Yearly or when malfunctioning
Clean the window	Clean lamp window every 40 hrs or less of operation
Recharge battery	When the instrument status reads LoBat

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K. Troubleshooting

- a) The battery pack installation sequence does not occur.

There is residual power in the unit. This can happen if the battery pack is removed and immediately reinstalled on the monitor. Wait two minutes and reinstall the battery pack.

- b) Instrument Status and Fault Displays
If your instrument does not work properly or if an error prompt appears, contact an MSA authorized service technician.

- c) Concentration Alarm Condition

Status Message	Concentration Alarm Condition
WARN	Indicates a warning level ceiling alarm.
ALARM	Indicates an alarm level ceiling alarm.
STEL	Indicates the amount of gas detected by the monitor during the current period is greater than or equal to the STEL limit.
TWA	Indicates the amount of gas detected by the monitor during the current period is greater than or equal to the TWA limit.

- d) System Alarm Condition

Status Message	System Alarm Condition
BATT	Indicates a low battery alarm.
LAMP	Indicates a lamp out alarm condition.

- e) Battery Condition

Status Message	Battery Condition
OK	Indicates remaining battery voltage is within an acceptable range.
LOW	Indicates the battery can only operate the unit for an additional 20 minutes of continuous operation.

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f) Peak Reading Condition

Status Message	Peak Reading Condition
Blank	Indicates that the peak reading displayed is less than the current warning and alarm thresholds.
WARN	Indicates that the peak reading displayed is greater than or equal to the current warning threshold.
ALARM	Indicates that the peak reading displayed is greater than or equal to the current alarm threshold.

g) STEL Condition

Status Message	STEL Condition
Blank	Indicates that the STEL displayed is less than the current STEL alarm threshold.
ALARM	Indicates that the STEL displayed is greater than or equal to the current STEL alarm threshold.

h) TWA Condition

Status Messages	TWA Condition
Blank	Indicates that the TWA displayed is less than the current TWA alarm threshold.
ALARM	Indicates that the TWA displayed is greater than or equal to the current TWA alarm threshold.

L. Miscellaneous

a. Storage

1. Store your Passport PID in a safe, dry place when it is not in use. Be sure that the storage area temperature is between 23 and 104 degrees Fahrenheit.
2. For long term storage (more than one month) remove the battery pack from the unit.
3. After long term storage, perform a calibration check before using the instrument. Failure to do so can adversely affect the accuracy of concentration readings.

- b. Refer to manual for details on setting the alarms and for further set-up procedures.

MicroFID
Flame Ionization Detector

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A. Application

Action levels to determine appropriate level of personal protection must be set before using MicroFID in the field. Use FSOP 1.01, Initial Site Entry, to set action levels.

The MicroFID uses a flame ionization detector for the measurement of combustible organic compounds in air at parts-per million (ppm) levels. The permanent air gases (argon, carbon dioxide, nitrogen, oxygen, water vapor, etc.) are not ionized by the flame.

When MicroFID is turned on, the display prompts you to turn on the hydrogen. The internal pump draws air in through MicroFID's inlet. This sample air provides the oxygen necessary for combustion in the hydrogen fed flame.

When the proper ratio of hydrogen to air is present in the combustion chamber, the flame is started automatically with a glow plug. A thermocouple is used to monitor the status of the flame.

When MicroFID is turned on, the display prompts you to turn on the hydrogen. The internal pump draws air in through MicroFID's inlet. This sample air provides the oxygen necessary for combustion in the hydrogen fed flame.

When the proper ratio of hydrogen to air is present in the combustion chamber, the flame is started automatically with a glow plug. A thermocouple is used to monitor the status of the flame.

When the sample passes through the flame the combustible organic compounds in the sample will be ionized. After the compounds have been ionized by the flame, the ionized particles are subjected to a continuous electric field between the repeller electrode at the jet (+75V) and the collector electrode.

The ions move in the electric field, generating a current which is proportional to the concentration of the ionized molecules in the ionization chamber. An electrometer circuit converts the current to a voltage that is then fed to the microprocessor.

After the sample passes through the flame and has become ionized it is vented from the detector through a flame arrestor. The flame arrestor prevents the flame from igniting any flammable gases present in the sampling location.

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B. Limitations

The presence of substituted functional groups (amino, hydroxyl, halogens) on a simple hydrocarbon reduces its combustion efficiency and thus MicroFID's sensitivity to the compound. Methanol and chloromethane, for example are detectable with MicroFID but not as well as methane. A greater number of carbon atoms can offset this loss of sensitivity due to substitution. For example, MicroFID is more sensitive to n-butanol than it is to methanol.

A minimum of 17% oxygen is required to start the hydrogen flame. A minimum of 10% oxygen is required to maintain the hydrogen flame. An oxygen deficiency will reduce the height of the flame or cause the flame to be extinguished and may affect the displayed reading.

High concentrations of flammable gases (gases within their flammable range) can act as an additional fuel source. When this happens, the flame height may increase beyond the confines of the combustion chamber. The hydrogen supply will then be cut off and the flame will go out.

Flame out may also occur when the concentration of sample gas is so great that it causes an oxygen deficiency. This may occur when sampling enclosed or confined spaces where vapors and gases cannot escape. Watch for indications of increased flame height such as erratic readings or sudden high concentrations followed by a flame out fault.

C. Safety

Cylinders of compressed gas, such as hydrogen and calibration gas, must be handled with extreme care. When using the calibration gas bag adapter, take care not to kink or stress the tubing. For safety, the hydrogen and calibration gas cylinders must be secured before use. Refer to manual for further precautions on compressed gases.

Hydrogen gas is a fire and explosion hazard when exposed to heat or flame. The lower explosive limit (LEL) is 4%. Empty the hydrogen gas cylinder before you transport the MicroFID.

Do not expose the instrument to excessive heat or cold.

Do not remove the battery or connect the charger to MicroFID in a hazardous location.

Do not aspirate liquid samples with MicroFID.

Do not replace the inlet filter in a hazardous location.

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Do not leave the MicroFID unattended during the filling procedure. It is possible to overfill the cylinder and damage MicroFID.

D. Equipment Composition

The MicroFID is intrinsically safe for use in atmospheres containing combustible levels of gases.

E. Checklist

Shoulder Strap
Sample Probe
User's Manual
Hydrogen Refill Adaptor
MicroFID Multi-Tool
Battery Charger with AC Line Cord
Replacement Sample Inlet Filters(10 pieces)

F. Starting the Flame

1. Press the front ON/OFF switch. The version number and creation date of the instrument software are displayed. Press ENTER.
2. You will be prompted to start the flame. If you do not want to start the flame, use the ARROW keys to select "No Flame Needed" and press ENTER. To start the flame use the ARROW keys to select Start Flame and press ENTER.
3. If you selected "Start Flame" , MicroFID will prompt you to turn start the flow of hydrogen and press ENTER.
4. The pump will start and MicroFID will then ignite the flame. You will hear a small pop when the flame has been ignited. Once the flame has been started the message "Detector flame has been started OK" will be displayed followed by the default display.

F. Set-up Procedures

The Set-up key is used to enter analysis information. Press SETUP and step through the options. Press ENTER to accept the displayed data or enter a numerical value using the keypad and then press ENTER. If no values are entered the display reverts to the default display after 15 seconds.

1. Turn POWER on. When the display changes from "WARMING UP NOW, PLEASE WAIT..." to "READY". The first option is for the detector. If you have been using the instrument with no flame and you now need to start the flame, use this option. You can also use this

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option to start the flame after a flame out fault. If you do not want to change the status of the detector use the arrow keys to select "No Change". Press ENTER to move to the next option.

2. The next option is Repair. Use Repair to record the state of repair. You must define the repair codes and ensure all users are aware of the codes. This option is most useful for Method 21 monitoring.

For example, a code of 0 may represent no repair under way, 1 may represent first attempt at repair with 5 days, 2 may represent final repair attempt within 15 days, 3 may indicate irreparable damage, and a 4 may represent a state in which a repair can not be attempted until the next scheduled shut down.

3. Next select the operating range. This option sets the full scale range for the bar graph display, the graph output. Use the ARROW keys to select a Range of 20, 200, 2000, 10000, 50000 ppm. This does not affect the MicroFID's numeric display and datalogging.
4. Select the Interval next. You can average data over intervals of 1 second(s) 5s, 10s, 15s, 30s, 1 minute(m), 2m, or 5m. You may also select Method 21 mode.

If you select Method 21, the datalogger will be cleared. If you do not want to lose your previously recorded data, press EXIT. Then print or save the data to disk before changing the interval to Method 21. See Sections 2.15, 2.16 and 4.2 in the manual for more information on printing and saving logged data.

Method 21 mode first prompts you to locate a specific sampling site and then allows you to record both a background and sample entry in the datalogger.

5. The data option is next. Enter the current day, month and year. Press ENTER to confirm the entry. The date is retained when the instrument is turned off. You do not need to enter this information every time you use MicroFID.
6. Next enter the correct time. Press ENTER.

G. EVENT Key

Events may be used to identify a particular sample or sampling location in memory. An event name is used in Method 21 operation to identify a sampling location. Recorded data are played, printed and removed from the datalogger by specifying a start and stop event name.

The EVENT key controls MicroFID's datalogger. Press the EVENT key to see the event options.

1. Press the ARROW keys until the "Insert" option is displayed.
2. To insert an event, press ENTER. You will be prompted to enter an event name. You can enter a numerical name directly from the MicroFID keypad or you can connect MicroFID to a computer and enter the event name using the STAR21 Software. An event name may be up to 16 characters long. Refer to the User's Manual for STAR 21 software for details of using the software with MicroFID.
3. Press the ARROW keys to move to the next option.
4. You can delete the current event, all recorded events or a range of events. Press ENTER then use the ARROW keys to select the desired option.

If you want to delete a range of events you must select a start and stop event. Use the ARROW keys to scroll through the list of events to select the start event and then to select the stop event.

5. You can turn the datalogger off by selecting Stop. MicroFID will continue to analyze, but no data will be stored. To turn the datalogger on again press the EVENT key and use the ARROW keys to select Start. MicroFID will begin logging data again.
6. You can find a specific event in the datalogger using the "FIND" option. Use the ARROW keys to scroll through the list of events to select the desired event. When you press ENTER, the selected event will be displayed. Use this option in Method 21 operation to find an event for monitoring or re-monitoring.
7. The next option is "Scan". You can use a bar code reader to scan a bare coded event name.
8. To activate the bar code reader, use the ARROW keys to select "Scan". Press ENTER to activate the bar code reader. It will remain activated until you scan a code. If no bar code is scanned within 15 seconds the bar code reader will be deactivated. This is done to conserve battery life. "Scan", when used with the bar code reader has the same function as the "Insert" option.

MicroFID can record continuously until the datalogger is full. When the datalogger is full the instrument status will change to "Endlog". The datalogger will stop logging data when it is full.

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If it is necessary to retain a copy of recorded data, the data should be printed or stored in a computer when "Endlog" is displayed. This will prevent loss of information.

H. Calibration Procedure

a) Calibrating MicroFID

1. Press CAL and select desired Cal Memory. MicroFID has 10 Cal Memories and can be calibrated with 10 different span gases or response factors if desired. Only one Cal Memory can be used at a time. Each Cal Memory stores a different response factor, zero point, sensitivity, and alarm level.
2. Enter the desired response factor and press ENTER. Refer to Appendix 8.5 for a list of Response Factors. If the compound is not in Appendix 8.5 or you are measuring gas mixtures then enter a value of 1.00. The concentration detected by MicroFID will be multiplied by the response factor before it is displayed and logged.
3. Select Low Range or High Range and press ENTER. Use Low Range if you are sampling concentrations between 0.5 and 2000 ppm(methane equivalents). Use High Range if you are sampling concentrations between 10 and 50,000 ppm(methane equivalents).
4. Connect the supply of zero air. If you are using room air press ENTER.
5. If you are using a charcoal filter, connect the filter as outlined in Section 4.5. Press ENTER and MicroFID will set its zero point.
6. If you are using a gas bag with zero air, connect the gas bag adapter to the inlet. Open the bag and press ENTER. MicroFID sets its zero point.
7. MicroFID then asks for the span gas concentration. Enter the known span gas concentration and then connect the gas bag adapter to the inlet. Open the bag.
8. Press ENTER and MicroFID sets its sensitivity.
9. When MicroFID's display reverts to normal, it is calibrated and ready for use. Remove the span gas bag from the inlet.

10. Press the ALARM key and enter the alarm level for the selected Cal Memory.

I. Documentation

The following information must be recorded in the instrument calibration and test log.

1. Instrument name and model.
2. I.D. or serial number.
3. Date and time of calibration.
4. Battery Check results.
5. Method of calibration.
6. Results of calibration.
7. Identification of calibration gas (source, type, concentration, lot number).
8. Signature of calibrator.

J. Routine Maintenance

a) Charging the Battery

1. When the instrument status displays "LoBatt", the battery pack requires charging. When the "LoBatt", status is displayed, you have a few minutes of operation left. MicroFID will turn itself off before the battery pack becomes critically low.
2. To remove the battery pack, stop the flow of hydrogen gas by turning the hydrogen shut-off valve fully clockwise. If the instrument has been turned on, turn it off by pressing the On/Off switch twice.
3. Use the MicroFID multi-tool to loosen the two captive screws in the bottom of the battery pack.
4. To charge the battery pack plug the charger into the jack located on the front of the battery pack. Plug the charger into the AC outlet.
5. The LED, on the battery pack, indicated the charge state. Red indicates the battery is being charged. Green indicates the battery is fully charged and ready for use.
6. When the battery pack is fully charged remove the charger, first from the wall outlet then from the battery pack.
7. Connect the charged battery pack to the retainer at the rear of the instrument.

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8. Use the MicroFID multi-tool to tighten the two captive screws into the bottom of the battery pack. Do not over-tighten the screws.

b) Emptying the Hydrogen Cylinder

1. Turn MicroFID off and open the hydrogen shut-off valve.
2. Remove the battery pack as outlined above.
3. Locate the purge outlet. It is located on the underside of the instrument.
4. Use the MicroFID multi-tool to turn the screw counterclockwise. Loosen the screw but do not remove it.
5. Leave the instrument so that the purge outlet is facing up. If the purge outlet is facing down, hydrogen will vent into MicroFID's case.
6. If the cylinder is full, it will take approximately 15 minutes to empty.
7. Watch the Contents Gauge. When the cylinder is empty, close the purge outlet. Use the MicroFID multi-tool to turn the screw clockwise.
8. Replace the battery pack.

c) Replacing the Sample Inlet Filter

1. Turn instrument off. Unscrew the filter housing from the detector housing. Be careful not to lose the O-ring seal.
2. Remove the Teflon/Polypropylene filter and install the new filter. Place the filter in the filter housing with the Teflon side facing down in the filter housing and the mesh side facing the MicroFID. Handle the filter disk only by the edges. The mesh may be damaged or contaminated by excessive handling. Use forceps if possible.
3. Replace the filter housing.
4. Calibrate all Cal Memories, that you are using, before continuing operation.

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K. Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Perform routine calibration	Prior to each use
Initiate factory checkouts and calibration	Yearly or when malfunctioning
Replace inlet filter	Once a week or more frequently if used in a dusty environment.
Recharge battery	When the instrument panel reads Lo-Batt.

L. Troubleshooting

- 1) No instrument response detected, yet compounds are known to be present.

Follow maintenance instructions in Chapter 6 "Troubleshooting" in manual.
- 2) Date and Time settings are not retained

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.
- 3) Cannot fill the internal hydrogen cylinder to 1800 psig.

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.
- 4) Instrument status shows "Over".

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.
- 5) Display contrast bars are on or display is blank.

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.

- 6) Sample flow rate varies from 600 ml/min. +/- 10%.

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.

- 7) Flame will not ignite.

Follow maintenance instructions in Chapter 6 "Troubleshooting" in the manual.

- 8) Liquid has been aspirated.

MicroFID has been exposed to a solvent that can pass through the Teflon/Polypropylene filter. Contact the Photovac Service Department for technical assistance.

- 9) Table Summary of MicroFID Status.

<u>Status</u>	<u>Code</u>	<u>Priority</u>	<u>Description</u>
NoFlm	N	1	Flame has not been ignited or flame has gone out.
Check	K	2	One of three faults is occurring. Press TUTOR for details.
Over	O	3	Detector electronics have been saturated.
Cal	C	4	Will never be observed on the display during normal operation as various calibration prompt messages are displayed while the MicroFID is calibrating.
Alarm	A	5	Detected concentration exceeds the set alarm level.
LoBatt	L	6	Battery pack power is low. Connect MicroFID to AC supply or replace the battery pack.
Play	P	7	The instrument is playing back previously recorded data.
Endlog	E	8	The datalogger is full.
HiSens	S	9	High Sensitivity operation.
Ready	R	10	Normal Operation.

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Locate	L	11	Locate site. Used in Method 21 operation.
BkGnd	B	12	Record background reading. Used for Method 21 operation.
Sample	S	13	Record sample reading. Used for Method 21 operation.

10) Fault Summaries

<u>Fault Description</u>	<u>Probable Causes</u>	<u>Corrective Action</u>
Detector Flame has gone out.	The hydrogen gas has run out.	Ensure the shut-off valve is open. Check the hydrogen contents gauge. Fill the cylinder if necessary. Ensure the cylinder outlet valve is closed.
Oxygen supply is deficient.	Poor connection between lamp holder and HF driver circuit board.	Check the wire joining the lamp holder to the HF drive circuit board. (See manual Section 4.2)
Signal from zero gas is too high.	Contamination of sample line or fittings.	Clean or replace line. Replace inlet filter.
	Span and Zero gas mixed up.	Ensure clean gas is used to zero meter.

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Detector field Contamination
voltage is low. in detector.

Contact DERR
Equipment and
purchasing
coordinator.

Short circuit
in detector.

See manual.

Internal fault
in electronics.

Contact Photo-
Vac Service
PhotoVac
Service
516-254-4283

GasTech GX-91 4 Gas Meter
For Air Surveillance

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A. Application

The GX-91 is a 4 gas meter that is designed and intended for for personnel safety in entering or occupying potentially hazardous confined spaces. The instrument has the capability of measuring LEL, O₂, SO₂, H₂S, CO, Cl₂.

Features:

Our instruments detects and measures for combustible gases (up to LEL) oxygen concentrations (0%-40%), H₂S (0-100ppm), and CO (0-500ppm). It has the capability to measure SO₂ (0-50 ppm) and Cl₂ (0-15 ppm).

Will give a read out of the peak and average gas exposures accumulated since the time the instrument was turned on.

Has data logging functions that can be down loaded to a computer.

Has a bar code option that can be used to identify the user and the location of the sampling event.

Has a "lunchbreak" feature that allows the instrument to be turned off during a break and turned back on again and still allow the user to retrieve the TWA and STEL for the whole day. The user can disconnect this feature.

B. Limitations

Use in oxygen-enriched atmospheres is beyond the normal scope of its intended purpose.

Samples of combustible gases that have more than the normal proportion on oxygen will give a normal reading. However, the flame arrestor used is not dense enough to arrest flames from the combustible gas in oxygen.

Certain substances can desensitize the catalytic surface of the platinum filament. This can result in reduced sensitivity or in failure to give a reading on samples containing combustible gas. The most common one are silicone vapors.

In oxygen deficient atmospheres where there is not enough oxygen to react with the combustible gases the instrument may read low. As a general rule, samples containing 10% oxygen or more have enough to give a full reading on any combustible gas up to the LEL.

In rich mixtures need to be careful of your interpretations of the readings:

Mixtures up to 100% LEL	Reading on scale
Mixtures between LEL and UEL	Reading at top of scale
Mixtures above the UEL	The meter first goes up the scale, then comes back down. Very rich mixtures will give close to a zero reading.

The CO sensor will respond to other gases even with it carbon filter in place. These gases are acetylene and hydrogen.

C. **Safety**

This instrument is intrinsically safe and may be operated in Class I, Division 1, Groups A, B, C or D hazardous atmospheres.

D. **Equipment Composition**

This instrument is encased in a stainless steel housing for RF resistance.

E. **Checklist**

GX-91, calibration gases, calibration log book, sample log book.

F. **Procedures**

To turn the instrument on depress the ON/OFF keypad. It will automatically run through it internal check and will initially make a single tone. When the sequence is complete it will sound a double tone. The display will show the measurement readings.

If you are going to use the pump, remove the perforated panel in the back. Carefully place the pump over the sensors and secure into place by tightening the screw. If needed, attach the sample probe to the pump. Note: there is a separate on/off switch on the pump that must be turned on in order for the pump to function.

To turn the instrument off depress the ON/OFF keypad for 5 seconds. During the time you depress the key a buzzer sounds off every second.

Other Functions

AIR keypad - this is to zero the instrument. By pressing and holding the AIR keypad a single tone will sound and start the

DEMAND ZERO. When the sequence is complete a double tone will sound and you releasd the AIR keypad. This causes the the O2 channel to set to 21.0% and the other channels to set to zero.

DISPLAY - provides multiple functions by continuing to press the keypad.

Bar code readings*	USER ID
	STATION ID
Peak readings	"P" (all channels)
Average readings	"A" (all channels)
Time since turn-on	In minutes
STEL	In ppm, for toxics only
TWA	In ppm, for toxics only
Battery voltage	Minimum (2.3V) and present ()
Current data	Date, time, and temperature
Clear data logger **	Yes or no
Remaining log time**	Hours and tenths
Measurement readings	HC O2 H2S CO

*Displayed only with the bar code reader attached
**Function related to the data logger retrieval option

When selected, each function will show for 20 seconds, then revert to the measurement readings. However, when the choice to clear the data logger is made, the display revets to the mesurement readings in only four seconds. This DISPLAY keypad is also used to reset the latched alarms and to restart the TWA/STEL averaging from a new "zero".

Alarm lights, %LEL, %O2, PPM, CO and PPM H2S are red LED's that blink in synchronism with the alarm tone when their respective preset alarm points are reached. They will remain latched int theis condition until they are reset by pressing the DISPLAY keypad.

G. Set-Up procedures
See above.

H. Calibration
The switches you need to properly calibrate this instrument are located on the right side of the instrument and under the small metal plate. Underneath the plate are 4 push button switches labeled ADJ, SET, -, +, and 1 toggle switch that is used to retrieve data from the logger.

The manufacturer recommends that this instrument is put on a regular maintenance schedule in order to keep it working properly.

- To start:
- 1) Turn the instrument on and allow it to go through its start up cycle.
 - 2) Allow it to warm up for at least 15 minutes.
 - 3) Press the ADJ switch and hold until you hear a single tone.
 - 4) Remove the perforated cover in the back to expose the sensors.

Methane for LEL

- 1) Press the ADJ button and this display will appear:

SET	HC	SPAN
YES:SET		NO:ADJ

- 2) Press SET to calibrate or press ADJ to bypass and go to the Oxygen calibration.

- 3) When you press SET this display will appear:

HC	CAL	<u>00</u>
APPLY GAS / ADJ /SET		
Not: the "00" will flash		

- 4) Open the control valve on the methane gas cylinder and adjust it to obtain a flow of ~1.0 SCFH on the flowmeter. Make sure the flowmeter is upright.

- 5) Slide the cup over the hydrocarbon sensor. Allow the reading to stabilize. If the reading is not the same as the calibration standard adjust the reading by depressing either the - , or + switches. When the display reads the correct value push the SET switch to lock the value in.

- 6) Remove the cup from the sensor and shut of the control valve.

Oxygen

- 1) Press the ADJ switch until you see this display:

SET	O2	ZERO
YES:SET	NO:ADJ	

- 2) Press the SET switch to zero the oxygen or press the ADJ switch to move to the H2S calibration.

- 3) When you press the SET switch this display should appear:

O2 ZERO 21.0
APPLY GAS / SET

The "21.0" will flash.

- 4) Attach the nitrogen/carbon monoxide cylinder to the control valve and open the valve and set the flow to ~1.0 SCFH on the flowmeter. Make sure that the flowmeter is upright.
- 5) Put the cup over the oxygen sensor and note the flashing reading it should drop to near zero.
- 6) Press the SET switch to lock the reading. The flashing will stop and the reading will drop to zero. In 5 seconds the display will go to the next setting.

O2 ZERO 00.00
APPLY GAS / SET

- 7) Close the control valve and remove the cup from the sensor.

Hydrogen Sulfide Calibration

- 1) Press the ADJ switch until this display appears:

SET H2S SPAN
YES:SET NO:ADJ

- 2) Press the SET switch for the hydrogen sulfide calibration or the ADJ switch to bypass to the carbon monoxide calibration..
- 3) When you press the SET switch this display will appear:

H2S CAL 00
APPLY GAS / ADJ / SET

- 4) Attach the control valve to the hydrogen sulfide cylinder and open the control valve. The pressure gauge should read above zero and the regulator should automatically produce an ~1.0 SCFH flow. Make sure the flowmeter is upright.
- 5) Remove the flowmeter and connect the tubing and cup and place the cup over the hydrogen sulfide sensor. Observe the flashing reading.
- 6) If the reading is not the same as the gas concentration adjust

the reading by using the +, and - switches. When you reach the correct reading press the SET switch; the flashing should stop. Within 5 seconds the display should advance to the next setting.

- 7) Close the control valve and remove the cup from the sensor

Carbon Monoxide

- 1) Press the ADJ switch to advance to the CO calibration. This display should appear:

SET	CO	SPAN
YES:SET		NO:ADJ

- 2) Press the SET switch for the CO calibration and this display should appear:

H2S	CAL	<u>00</u>
APPLY GAS / ADJ / SET		

- 3) Attach the control valve to the nitrogen/carbon monoxide cyclinder and set the flow to ~1.0 SCFH. Make sure that the flowmeter is upright.
- 4) Before placing the cup onto the sensor make sure that the activated charcoal filter is over the sensor.
- 5) Observe the flashing reading. If the reading is not the same as the gas sample adjust the reading by pressing the - , or + switches.
- 6) When you have the correct reading press the SET switch to lock the reading. Within 5 seconds the display will automatically advance to the next setting.
- 7) Close the control valve and remove the cup from the sensor.

Sulfur Dioxide and Chlorine Calibration

- 1) These sensors go in place of the H2S and CO sensors.
- 2) Use the same steps as the H2S calibration except use the correct calibration gas. If using SO2 and suspect that H2S is present make sure that the scrubber is in place.

Date and Time Setting

- 1) After the last gas is calibrated the date and time setting display will appear:

SET DATE /TIME
YES:SET NO:ADJ

- 2) Press the SET switch to set or the ADJ switch to bypass.
- 3) When you press the SET switch this display will appear:

SET DATE / TIME
04 01 97 12:12
And the month value will flash.

- 4) If the correct month is not displayed use the - , or + switches to set the correct month. Press the SET switch to lock the value in place. The month will stop flashing and the date will begin to flash.
- 5) Repeat the above steps until the date and time is correct. After the final SET switch is pressed the display will read this within 5 seconds:

HC	O2	H2S	CO
BB.B	II.I	LL.L	LL.L

Finishing Calibration

- 1) Replace the perforated cover screen.
- 2) The instrument is now ready for use.

Alarm Settings

<u>Gas</u>	<u>Low</u>	<u>High</u>
HC	10%	50%
O2	19.5%*	22%**
H2S	10ppm	NA
CO	35ppm	NA
SO2	2.0ppm	NA
Cl2	2.0ppm	NA

- * For falling O2 concentrations
** For rising O2 concentrations

Note: The alarm settings are adjustable and can be changed.

I. Documentation

Need to document every time that you calibrate the instrument.

Need to document what instrument that you are using, the weather

conditions and the readings.

Need to document if there are problems with the instrument.

Need to document whenever service is done on the instrument.

J. Maintenance

Batteries:

- 1) To check voltage press DISPLAY key 6 times or you can check the voltage when the instrument is first turned on.
- 2) Even when the instrument is turned off there is a small amount of discharge. Therefore if the instrument is not used the batteries may be drained. If the instrument is used infrequently you should remove the batteries from the instrument.

Sensors:

Combustible sensor may need replacement when:

- 1) %LEL display will not read 00% when the initial cycle is complete.
- 2) Cannot calibrate the instrument on a known gas within the "+" and "-" keys.

Oxygen sensor may need replacement if:

- 1) Cannot obtain a zero reading when calibrating with oxygen free gas.
- 2) Oxygen display does not read 21% after the initial cycle is completed.
- 3) The oxygen reading drifts with a change in the position of the instrument.

H₂S, CO, SO₂ or Cl₂ sensors may need replacement if:

- 1) Cannot calibrate instruments with a known gas using the "+" and "-" switches.
- 2) The display does not read "00" for H₂S, SO₂, or Cl₂ or "000" for CO.

Note: These sensors require conditioning by supplying them with low power continuously. This will occur when the batteries are in place. (It doesn't matter whether the instrument is turned on or off.) If the voltage is interrupted for an extended period of time they will require stabilization. You can remove the batteries or the sensors for a short time without needing to stabilize the instrument.

Do not expect a new toxic sensor to give correct readings immediately after it has been plugged into the instrument or after dead batteries have been replaced. Wait an hour before attempting to use the instrument, and up to 12 hours for final stabilization.

Replacement: *Sensors are not interchangeable and each sensor must be placed in its own socket.*

CO and SO2 Filters

Each of these sensors has a filter that is fitted over the top of the sensor. The CO sensor has an activated charcoal filter that removes H2S and most hydrocarbons eliminating many possible sources of interferences. The SO2 filters removes H2S.

Note: Both the CO and H2S filters can accept the charcoal filter. Therefore make sure that you place the filter on the CO and not the H2S filter!

K. Abnormal Operations

Safety Self-Check

If you hear a continuous "trouble" tone a sensor circuit has failed "open". You need to turn the instrument off and then turned back on for continuous use.

Emergency Operation

If one or more of the sensors fail you can still operate the instrument with the remaining sensors if the bad sensors are disconnected at the time of the turn-on. When this is done you will hear 7 audible pulses and it will adjust for the remaining sensors and give an "XX" display for the defective sensors.

SCBA Maintenance,
Cleaning, and Storage

FSOP: 14.01
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 8

A. Objective

To ensure the proper maintenance, cleaning and storage of the self-contained breathing apparatus (SCBA) used by DERR staff, in compliance with the Agency's Respiratory Protection Policy (OEPA-SM-06-002) and 29 CFR 1910.134.

F. Procedures

1. The SCBA shall be visually inspected and tested for defects and problems prior to each use. See ATTACHMENT A.
Exception: SCBA's used for emergency response shall be visually inspected and tested on a monthly basis. It is the responsibility of the OSC assigned to the unit to keep a record of the inspection date and findings. See ATTACHMENT B.
2. The SCBA facepiece shall be cleaned after each use. See ATTACHMENT C.
3. The SCBA unit shall undergo a flow test (bench test) on an annual basis. District Office/Division Administrative Assistants shall arrange for these tests. The date tested shall be entered on the SCBA Maintenance Record. Only certified technicians shall perform these tests. See ATTACHMENT B and ATTACHMENT F.
4. The SCBA air cylinders shall be hydrostatically tested as follows: every 3 years for composite tanks, and every 5 years for steel tanks. District Office/Division Administrative Assistants shall arrange for the test through a local vendor. The A.A. shall keep a record of the test dates. See ATTACHMENT D.
5. The SCBA shall be overhauled every 3 years. The A.A. shall make arrangements. A record shall be kept of the overhaul. See ATTACHMENT B and F.
6. SCBA cylinders shall be recharged with air conforming to Compressed Gas Association Specification G-7.1, Grade D or higher quality. Arrangements for filling shall be made by the A.A. to be performed by a local facility. DERR employees may have this done at the DERR Field Facility.
7. The SCBA shall be stored as indicated in ATTACHMENT E.
8. The A.A. or designated equipment personnel shall send SCBA's in need of repair to an approved vendor. Repairs are to be made by certified individuals only.

ATTACHMENT A
INSPECTION AND TESTING

1. **Facepiece:**
The facepiece skirt and headstrap should be inspected for pliability and signs of deterioration. Stretching and manipulating the rubber with a massaging action will keep it pliable and flexible and prevent it from taking a set during storage. All parts, especially the lens, should be clean and free of dirt and dust. Attach a lens scratch guard for added protection. Examine the buckles to see that they function properly and are free of excessive rust. Check the facepiece for leaks. Special attention should be given to the exhalation valve and the joint between the lens and the skirt. Exhalation should be smooth, with no sticking of the exhalation valve.
2. **Low Pressure Hose:**
Examine the end fittings for damaged threads and freedom of movement. Check the O-rings for damage. Stretch the hose and check for holes, cuts, tears, or cracks. Check that the clamps are properly securing the hose to the mask.
3. **Regulator:**
Prepare the SCBA for use, don the facepiece, and breath. The regulator should deliver ample quantities of air without fluttering or free-flowing. Ensure that the Emergency By-Pass is shut off. Also, check for leaks and tightness of all fittings.
4. **Intermediate Pressure Hose:**
Inspect the hose for leaks, cracks, cuts, and abrasions. Check the end fittings for tightness.
5. **Alarm Bell:**
 - a. Close the Emergency By-pass valve;
 - b. Open the cylinder valve;
 - c. Close the cylinder valve.
 - d. While observing the regulator pressure gauge, slowly vent air from the system by opening the Emergency By-Pass valve. The alarm bell should ring when the gauge reads approximately $\frac{1}{4}$ full;
 - e. Close the Emergency By-Pass valve when all air has been vented.
6. **Cylinder Valve:**
Check for leakage or excessive operating torque.
7. **Pressure Gauges:**
Check the air cylinder and the high and low pressure regulator gauges for leakage, impact damage, or an excessively scratched lens. Also check for a loose or bent pointer and obviously inaccurate readings. Make sure the air pressure on the cylinder gauge is in the green zone, indicating a full charge.

8. **Compressed Air Cylinder:**

Check the hydrostatic test date on the cylinder. The latest date shown should not be older than three years (for composite cylinders) Examine the exterior of the cylinder for nicks, cuts, gouges, and any delaminations. Report damage to the A.A.

9. **Back Pack:**

Check the back pack for broken, twisted, or excessively frayed straps, defective or excessively corroded buckles, defective stitching, and MSHA/NIOSH approval plate missing or illegible.

ATTACHMENT B
SCBA Inspection and Maintenance Record

Regulator Serial Number: _____
OEPA Inventory Number: _____
Division #: _____

DATE	Inspection/Maintenance (indicate if overhaul, flow test or inspection)	FINDINGS	INITIALS

NOTE: A copy of this record shall be kept with the SCBA and a copy shall be maintained by the A.A.

ATTACHMENT C
CLEANING

1. For sanitary reasons, the facepiece should be cleaned and disinfected after each use, even if it does not look dirty.
2. Make a cleaning solution by mixing hot water with any detergent that contains effective disinfectants, such as quarternary ammonium compounds. A number of commercial respirator cleansers are also available.
3. Immerse the facepiece in the cleaning solution.
4. Using a soft brush, gently clean the facepiece. Pay particular attention to the area of the mask that contacts the face.
5. Rinse the facepiece in a fresh water bath and allow it to air dry. Mild heat (less than 160 F) may be used to speed up the drying. Use of a towel to dry the facepiece is not recommended unless a clean, lint-free towel is used.
6. Use caution when cleaning the facepiece lens. Although the outer surface of the lens has a proprietary anti-scratch coating, it can be damaged through careless or abusive handling. Do not attempt to "polish out" scratches with any abrasive agent as this will only cause further damage to the remaining coating. Warm, soapy water (using Joy, Mr. Clean, Simple Green, Lestoil, etc.) is usually adequate to remove adhering grime. Stubborn deposits may require the use of denatured or isopropyl alcohol or other mild solvents. Do not allow any solvent to come into contact with rubber, silicon, or plastic parts. Use solvents only in a well-ventilated area.
7. Apply Survivair anti-fog (PN 9510-15) to the inside of the lens.

For disinfecting your masks quickly, Survivair offers an alcohol wipe (PN B1400-96). **Do not wash the inside of the lens cover with alcohol wipes.**

Warning: Do not submerge the SCBA backpack and regulators in water. Water will damage the inside of the primary and secondary regulators, resulting in damage to be repaired by a certified technician.

FSOP: 14.01
Date: April 1, 1997
Revision #: _____
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ATTACHMENT D
SCBA Maintenance Record

Tank Serial Number: _____
OEPA Inventory Number: _____
Division #: _____

[illegible]

ATTACHMENT E
STORAGE

The SCBA should be stored to protect it against dust, sunlight, heat, extreme cold, excessive moisture, or damaging chemicals. It should be quickly accessible at all times and should be stored in compartments or cases manufactured for that purpose. These containers/compartments should be clearly marked.

Prior to storage, the following steps should be taken:

1. Place a fully charged air cylinder in the back pack.
2. Check that the cylinder valve locking ring is in the **LOCKED** position.
3. Close the emergency by-pass valve. If the regulator pressure gauge reads a pressure, there is air still in the airline. Open the emergency by-pass valve to bleed the hose. Re-close the emergency by-pass valve. The pressure reading on the pressure gauge should read zero.
4. Extend the underarm straps so that less than 6 inches of strap protrude through the buckles.
5. Extend each web of the headstrap fully.
6. Place the facepiece in a plastic storage bag to protect the lens and place the mask in the lower right hand corner of the SCBA carrying case.
7. Store spare cylinders in a secure, upright or angled position where they are not in danger of being punctured, toppled, bumped or damaged in any way.

ATTACHMENT F

Regulator #: _____ Test Date: _____
 Technician: _____
 SVA Certification #: _____ Test Bench Serial #: _____
 Reason for Test: (Check) ☐ Annual Testing ☐ Following Overhaul ☐ Troubleshooting

TEST	Bench Setting/Reading Tolerance	Actual reading	Action Taken
1. Pressurize	Set: -NONE- Range: LP @ 2000 / HP @ 2000 Attach facepiece to Bench Head - No Leaks	N/A	N/A
2. Alarm sounds while being pressurized	Set: LOCKUP; LOCKUP AND LEAKAGE Facepiece hose not attached to regulator Range: Alarm will sound at approximately: 0-600 psig on Low-Pressure Units and 0-1200 psig on High-Pressure Units		
3. Lockup or static facepiece pressure	Set: LOCKUP; LOCKUP AND LEAKAGE Attach facepiece hose to regulator and switch to positive pressure if necessary. Range: 1.0 to 1.5 inches H ₂ O		
4. Constant flow on positive pressure	Set: Power Switch on Low INHALE; INHALE AND LEAKAGE. Turn flow control knobs slowly to 200 lpm. Range: At 200 lpm, 0 inches H ₂ O or greater effort.		
5. Bypass flow (Test 3 times)	Set: INHALE; INHALE AND LEAKAGE. Turn off flow control knobs. Turn regulator bypass to full flow or until flow reaches minimum. Range: Minimum 118 lpm.		
6. Gauge reading	Set: LOCKUP; LOCKUP AND LEAKAGE Range: Gauge on unit must match bench gauge-plus or minus 1/4 smallest increment reading on gauges accuracy allowed.		
7. Lockup or static facepiece pressure -B	Set: LOCKUP; LOCKUP AND LEAKAGE Range: 1.0 to 1.5 inches H ₂ O		
8. Constant flow on demand (if applicable) Negative Pressure	Set: Power on Low. INHALE; INHALE AND LEAKAGE. Adjust flow control knob to 200 lpm. Range: At 200 lpm: -2.0 to 0		
9. Subjective Breathing Test	Set: None Range: Acceptable to experienced tester using mask belonging to SCBA. Breathe through mask on positive and negative pressure setting.		
10. Alarm Activation Pressure	Set: LOCKUP; LOCKUP AND LEAKAGE Depressurize air input source slowly Range: LOW PRESSURE MK2 500 to 650 psig / XL 443 to 554 psig Range: HIGH PRESSURE MK2 990 to 1250 psig / XL 900 to 1125 psig Must ring continuous to minimum pressure of 200 psig or 5 minutes breathing time.		
11. Facepiece	Set: Power on low. INHALE, INHALE AND EXHALE. Adjust flow control knob. Range: Effort not to exceed 2.0 inches effort greater than lockup pressure at 85 lpm flow.		

**Self-Contained Breathing Apparatus (SCBA),
Operation and Use**

FSOP: 14.02
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 6

A. Application

To ensure the proper operation and use of the self-contained breathing apparatus (SCBA) by the Division staff.

B. Limitations

All requirements indicated in the SOP for SCBA Maintenance, Cleaning and Storage (FSOP 15.01) shall be followed prior to use

C. Safety

Employees shall perform a negative pressure test on the facepiece as indicated in ATTACHMENT B prior to use. If either test fails, reposition the facepiece and try again. If the leak persists, do not use the SCBA or enter the exclusion zone.

E. Checklist

See ATTACHMENT A and B

F. Procedures

See ATTACHMENT A for procedures for donning the SCBA.

ATTACHMENT A

OPERATION

1. Lift the unit out of the carrying case.
2. Check that the first-stage regulator is securely attached to the cylinder valve outlet. Tighten by hand only.
3. Check the cam-lock on the cylinder band; make sure that cylinder is secure in backpack.
4. Don the unit by placing left arm through the left shoulder strap and right arm through right shoulder strap (like putting on coat) (Figures 1A & 1B)
5. You may also don the unit by lifting it up and over your head. (Figures 2A, 2B & 2C)

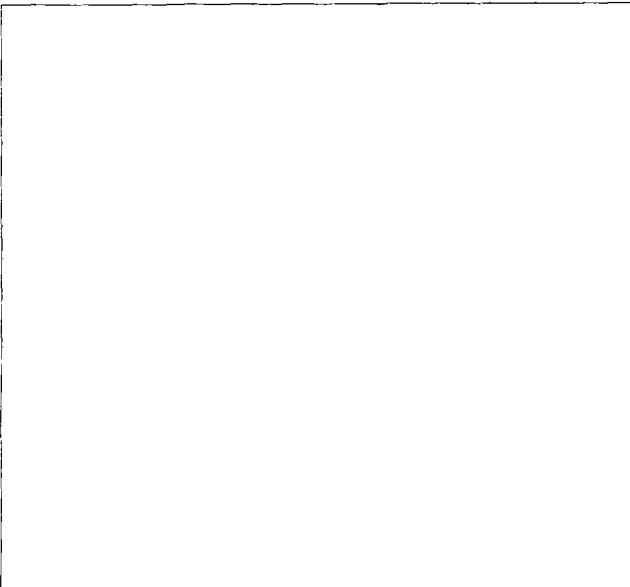


Figure 1A

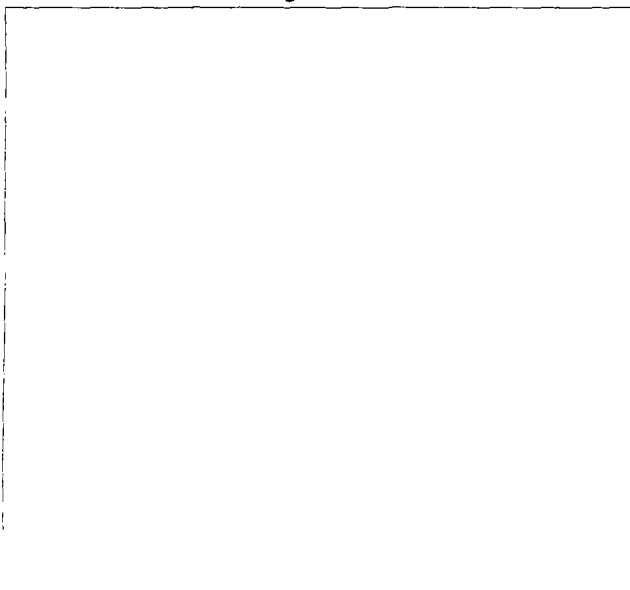


Figure 1B

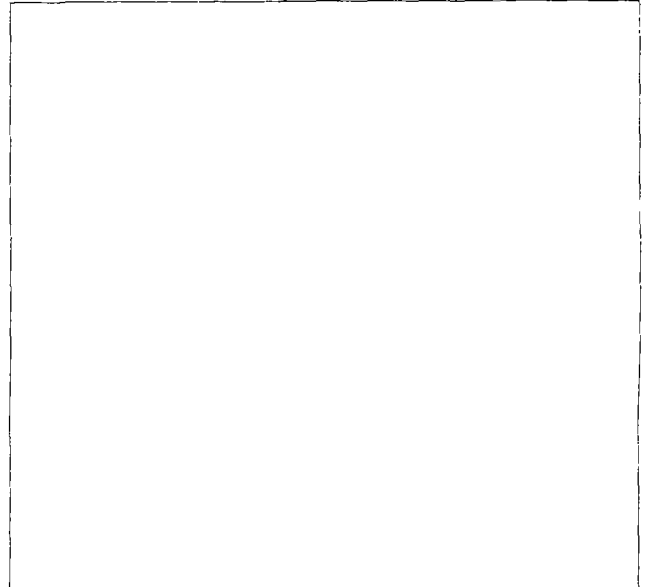


Figure 2A



Figure 2B

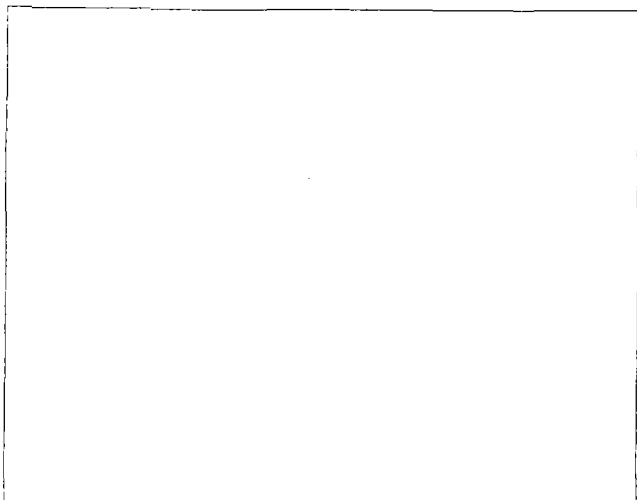


Figure 2C

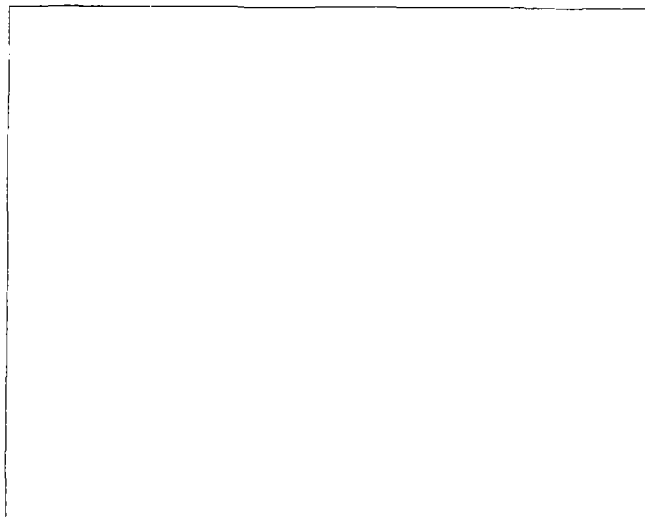


Figure 4A

6. Bend forward and pull the shoulder adjustment straps until the back support strap rests in the small of your back (Figure 3).

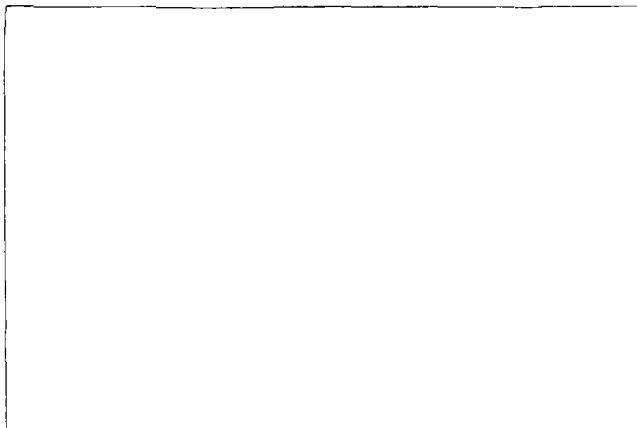


Figure 3

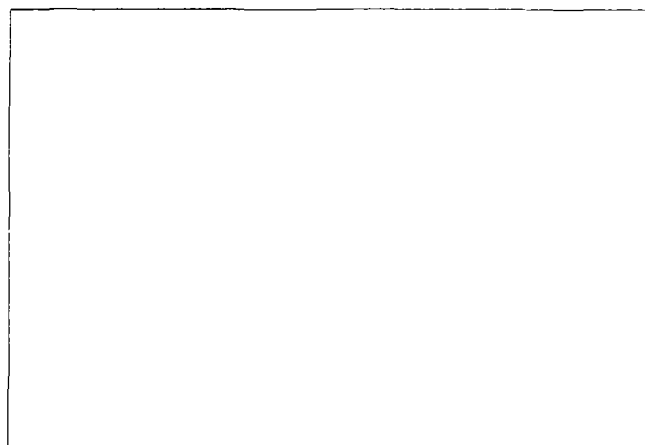


Figure 4B

NOTE

Turn the red Bypass Control Ring (on second stage regulator) away from emergency arrow indicator before opening valve cylinder.

7. Clip the snap-hook to the D-ring on the waist strap. (Figure 4A) Pull the free end of the strap to tighten. (Figure 4B)
8. Clip the snap hook on the regulator strap to the waist belt D-ring; pull the free end of the strap to tighten (Figure 4C).

9. Open the cylinder valve (Fig. 5) and check the pressure reading on the regulator pressure gauge. The gauge indicator should show a "FULL" charge. Be sure the valve-handle locking ratchet is engaged to prevent accidental valve closure.

tighten the straps. Seal the hose connection with the palm of your hand, inhale to check for mask leakage.

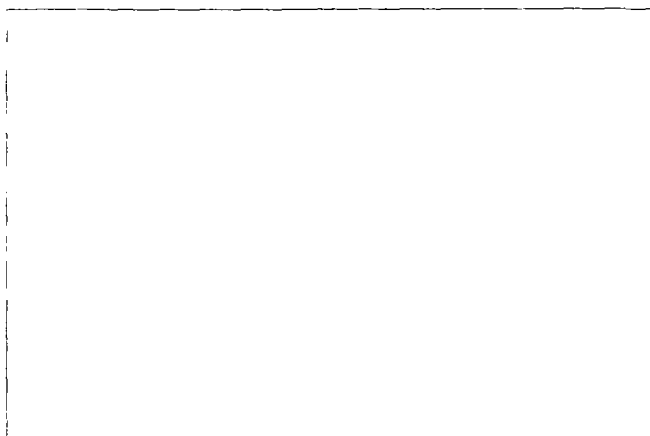


Figure 4C

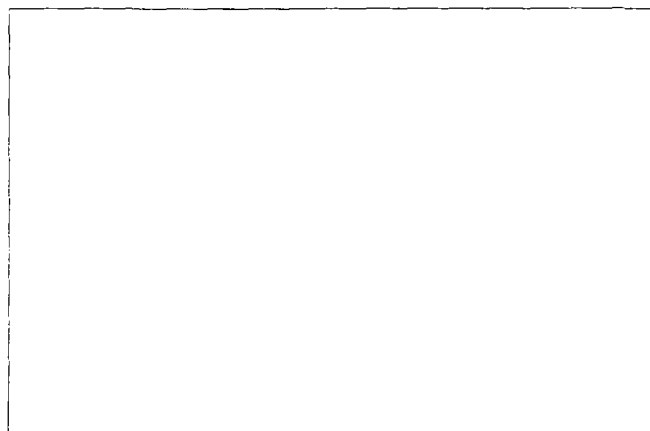


Figure 5

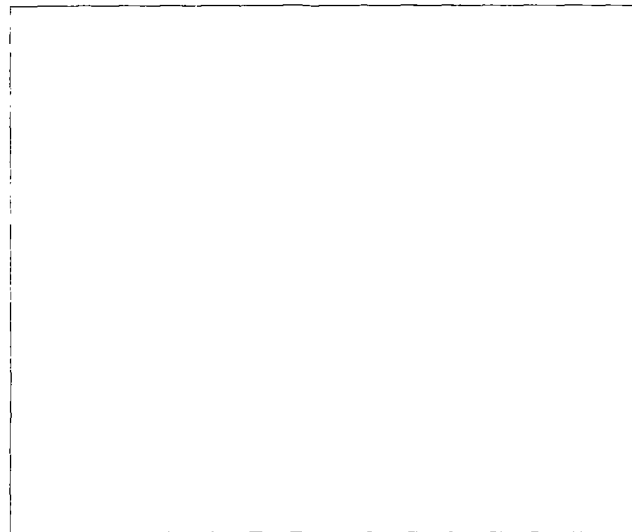


Figure 6

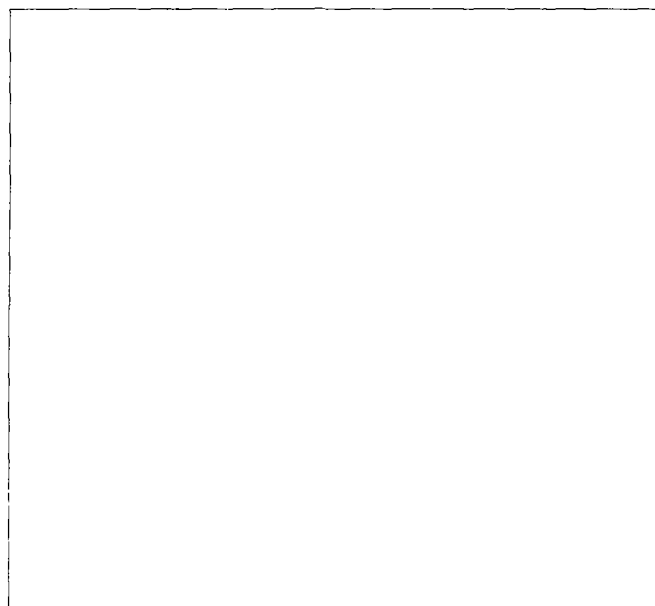


Figure 7

10. Adjust the head harness bottom straps on the facepiece to fully out. IMPORTANT: Adjust the top straps to approx. 2" through the buckles before donning. This procedure MUST BE FOLLOWED to ensure proper facepiece adjustment. Grasp the facepiece with your thumbs looped through the top straps; then pull the straps up, over your head and fully down the back. (Fig.6)
11. Place your chin against the shin stop. Tighten the two bottom straps. (Fig. 7) Do not over-

12. Attach the low-pressure hose to the regulator. (Figure 8 & 9)
13. Inhale and exhale to check regulator operation. Your SCBA is now ready for use.

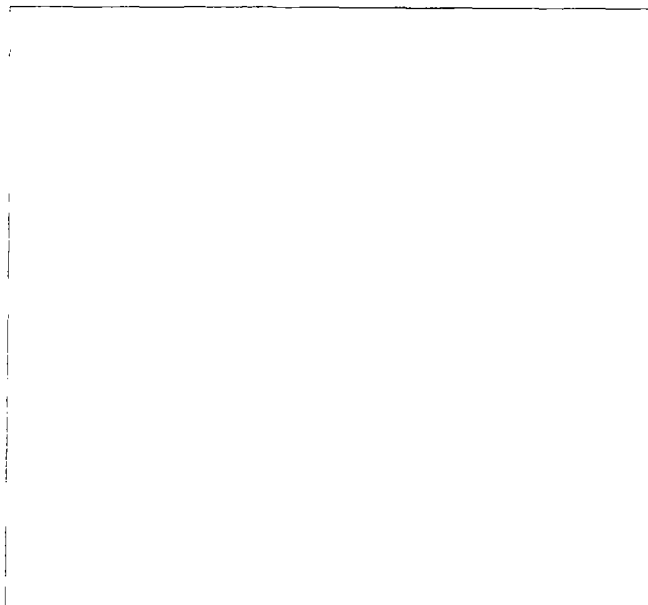


Figure 8

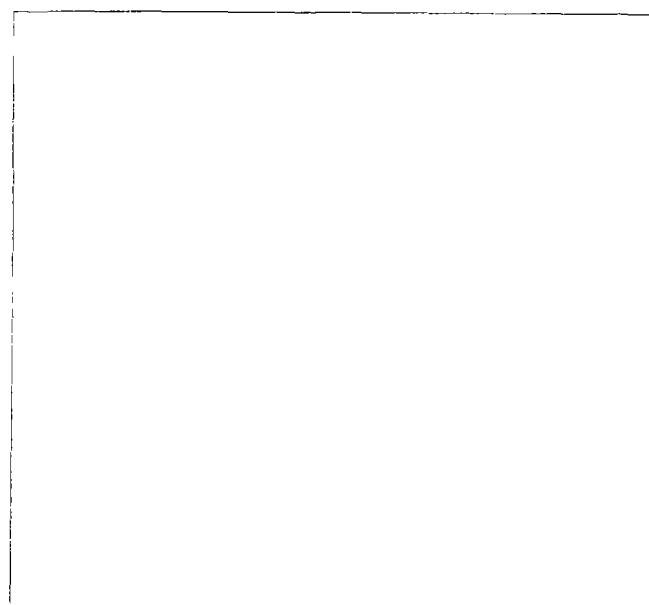


Figure 9

WARNING

Your SCBA has a rated service duration of 30 or 60 minutes.

This means that the unit will provide a service duration of 30 or 60 minutes when tested according to the Code of Federal Regulations, Title 30, Subpart 11. The actual service duration will frequently be less than 30 or 60 minutes, depending upon the user's physical condition, the level of exertion, the initial cylinder pressure, the ambient temperature, etc. In any case, when your low-air alarm bell starts ringing, PROCEED IMMEDIATELY TO A SAFE AREA! The alarm bell will start ringing (under average conditions) when you have approximately 6 minutes of breathing time left on a 30 minute unit and approximately 12 minutes on 60 minute units.

ATTACHMENT B
POSITIVE AND NEGATIVE PRESSURE TEST

Negative Pressure Test:

1. Don the facepiece.
2. Block the inlet of the hose with the palm of your hand.
3. Inhale gently so that the facepiece collapses inward slightly and hold your breath for about 10 seconds. The collapsing indicates that there is a negative pressure in the facepiece.
4. Face fit is considered satisfactory if the facepiece remains in its slightly collapsed condition for the duration of the test and no inward leakage of air is detected.
5. Remove hand from the hose.

Positive Pressure Test:

1. With the facepiece in place, close off the exhalation valve by temporarily covering it with the palm of your hand.
2. Exhale so that the facepiece is slightly distended or enlarged, and hold your breath for about 10 seconds.
3. Facepiece fit is considered satisfactory if the facepiece remains in its slightly distended condition for the duration of the test and no outward leakage of air is detected.
4. Remove hand from the exhalation valve.

**Photovac 10S/50 Portable
Gas Chromatograph**

FSOP: 15.01
Date: April 1, 1997
Revision #: _____
Approved by: _____
Page 1 of 10

A. Application

Action Levels: Sensitivity of the instrument enables the user to reach the ppb levels and up to several hundred ppm. If the Ionization Potential (IP) of the chemical to be tested is less than 10.2 ev, it will be detected.

Air Analysis: The Gas Chromatograph is a Photoionization Detector (PID) that operates using UV light produced by a lamp. As a mixture of chemical compounds passes through the GC column along with a carrier gas, it will separate each compound according to its boiling point. Those with lower boiling points elute or pass through the column quicker, taking a characteristic amount of time (retention time) to elute. Heating the column will help those chemicals with higher boiling points to elute more quickly.

The compounds proceed through the column to the detector. The detector consists of a small chamber containing a UV light source and two electrodes, across which an electric current is produced to ionize the compounds. The positive ions collect on the negative electrode which is connected to an amplifier, producing characteristic peaks to be processed onto the printer/plotter.

Water and Soil Analysis: In dealing with water and solids, this PID analyzes only gas samples that are in equilibrium with the liquid or solid phase. For liquids, shaking or heating to create headspace air is appropriate for obtaining a gaseous sample. Soil and sediment samples can be analyzed by performing an aqueous extraction, then injecting headspace air just as with water samples.

Operating Temperature: 10 degrees C to 35 degrees C (50 degrees F to 95 degrees F).

B. Limitations

For most practical purposes, a proper operating range for the GC lies between 10 degrees C and 35 degrees C. Under cold and/or moist weather conditions, the GC should be situated in a fixed shelter. It is also preferred that it not be exposed to wind or direct sunlight.

The GC is not sensitive to all chemicals. Most compounds with ionization potentials above 10.2 ev and/or have high boiling points will not be detected. On page 9-3 of the manufacturer's manual, there is a list of compounds that are not effectively photoionized; therefore, they are considered unsuitable for detection. Exceptions to this list are also noted on page 9-3 of the manufacturer's manual.

C. Safety

This instrument is not intrinsically safe.

The GC is run on electrical power which can be a possible source of ignition in hazardous atmospheres.

Refer to manufacturer's recommendation.

Refer to site specific Health and Safety Plan.

D. Equipment Composition

The Gas Chromatograph is not intrinsically safe.

E. Checklist

10S Portable Gas Chromatograph
Mains cord
Syringes
Packet of septa
Male quick-connect fitting
Plotter paper
Printer/plotter cover
Four colored pens
Battery pack
Column conditioning adapter
Carrier gas supply
Carrier gas regulator
Gas bags for standards
Gas bag adapter
Operating manual
Logbook

F. Procedures

I. Operation

The following process allows the user to set up for manual operation, checking that the computer's status report corresponds to the manufacturer's specification sheet.

1. ON key: Upon depressing this key, the instrument LCD will display LAMP NOT READY ENTER COMMAND.
2. TEST key: Followed by the ENTER key, the printer will print a status report corresponding to the specification sheet. The report includes such information as the date and time of factory set-up, source field and source power (within 20% of set-up value), and a matrix comprising various valve time

settings used (must correspond exactly with the specification sheet).

3. LIST key: Creates a response of LIST LIBRARY #?. Press the numeric key corresponding to the library referenced on the specification sheet, then ENTER. A list of all the compounds stored in this library is printed, along with identification numbers, retention times and limit values.
4. GAIN key: Pressing this key gives a response of SET GAIN TO? 2. Press the UP arrow until the GAIN number corresponds to the specification sheet, then press ENTER.
5. CYCLE key: The response will be TIMER DELAY? and gives a time in seconds. Press ENTER and a new response, ANALYSIS TIME with a value will appear. Check all values in the memory against the specification sheet using the numerical key pad and the CLEAR key to make any necessary adjustments.
6. USE key: This key ensures the library in use is the one listed on the specification sheet. Press ENTER and put in the correct date and time (military).

II. External Controls

1. EXT. DC: This 14v maximum inlet is one way of providing power to the instrument by connecting an external battery pack. The unit also has its own internal rechargeable battery which can provide up to ten hours of operation.
2. EXTERNAL CARRIER IN: This is the receptacle for an external source of carrier gas at a constant supply of 40 psi "air ultra-zero."
3. REFILL: This is a high pressure quick-connect fitting for refilling the internal reservoir with the ultra zero air. This allows the instrument to be more portable.
4. DELIVERY: This gauge indicates the pressure at which the carrier gas is being delivered.
5. CONTENTS: This gauge should be used during filling as a further safeguard against over pressurization; the reading should not exceed 1750 psi.
6. MANUAL INJECTION ports: These ports are provided to introduce small samples with gastight syringes.
7. OUTPUT: This receptacle can be connected to an external

chart recorder or other device (optional because the instrument has its own built-in plotter).

8. ON key: Turns on the computer, begins UV lamp warm-up and tests the plotter pens.
9. LIST key: This prints the compounds, retention times and limit values for the specified library.
10. EDIT key: Edits and deletes compound information in the current library.
11. USE key: Asks which library is to be used, and sets the date and time.
12. STORE key: Stores compound information from the last analysis into the current library.
13. CYCLE key: This key programs the timer delay, analysis time, cycle time, calibration frequency and TWA interval.
14. EVENT key: This key programs valve and pump times.
15. INFO key: Allows the user to add three lines of information regarding each injection that will print with the analysis.
16. CAL key: This key updates the library compound information. It reprints the last analysis report.
17. GAIN key: Sets the detector sensitivity from a range of 2 to 1000 by using the arrow keys.
18. CHART key: Sets the plotter format and chart speed by using the arrow keys:
 - a. Chart on with set-up: full analysis report
 - b. Chart on with baseline: no set-up information
 - c. Chart on: no set-up or baselines
 - d. Chart off: no set-up or chromatogram
19. SENS key: By use of the arrow keys, the integrator start and stop points are set based on the slope of the signal. PW at 4 min adjusts for peak broadening.
20. WINDO key: This key sets the retention time window for peak identification using the arrow keys. Peak must appear

within +/- Windo % of stored retention time for identification.

21. AREA key: Sets minimum area to be identified by using the arrow keys. Peaks with areas less than minimum will be numbered on the chromatogram, but will not appear in the analysis information. Range 5 to 1000 mV/s.
22. START/STOP key: Starts and stops analysis.
23. PEN key: This key changes the pen color, positions the pen for replacement and stops the plotter.
24. FEED key: This key feeds the plotter/paper and starts the plotter.
25. LIBRARY: There are four separate libraries available within the computer for storing information. Each library will store up to 25 compounds by name, retention time, response factor and limit value. This information is retained in the computer's memory even when the instrument is turned off.

III. Filling Carrier Gas

Use high purity air of no more than 0.1ppm hydrocarbon

contamination (ultra zero, zero-zero or ultra pure air). To supply the carrier gas, recharge internal reservoir with the high pressure filling adapter.

Attach the high pressure fitting to the gas cylinder and turn the valve handle so that it points away from the cylinder. Open the cylinder valve and check that there are no leaks. Now turn the filling adapter valve so that it points toward the cylinder. This serves to purge the hose of any impurities. Return the valve to its original position. Insert the quick-connect fitting at the end of the hose into the REFILL receptacle on the GC, pressing firmly until a click is heard. Turn the valve so that it once again points toward the cylinder.

Carefully watch the CONTENTS gauge on the GC, making sure it does not exceed 1800 psi. Turning the valve 180 degrees allows high pressure gas trapped in the flexible hose to escape. After relieving the gas pressure in the hose, detach the quick-connect fitting from the REFILL receptacle by pulling upward on the knurled collar and extracting the fitting.

IV. Event Programming

Properly programmed, this function allows manual injection of samples. The GC can be programmed to perform automatic sampling at specific intervals, but we do not yet use the instrument in this manner. Instructions for programming and manual injections are found in Chapter 6.

V. Adjusting Flow Rates

It is useful to experiment with different flow rates. Increasing a flow rate may save time by decreasing a compound's retention time, but it may also lose resolution of multiple peaks. Another shortcoming to increasing the flow rate is decreased sensitivity due to a shorter residence time in the column and detector chamber. To achieve an optimum flow rate, adjust the manual injection flow knob to run 10 ml/min.

To ensure that the column is free from contamination, it is necessary to maintain a continuous flow, while in use.

VI. Column Oven

The column oven is electrically independent of the instrument, and requires its own power supply. Its power switch is located beneath the computer. To use, open the module and rotate the oven temperature selector switch so that the arrow on top of the switch points to OFF. Connect a fully charged battery pack to the EXT DC port using the power cord. Ensure carrier gas is flowing through the column. Rotate the temperature selector switch on the oven so the arrow points to the desired temperature. A series of green LEDs beside the select switch indicates the temperature setting. Allow the oven to warm-up for approximately 20 minutes before running an analysis. Switch the oven off when not in use.

The oven will maintain a maximum temperature differential of 25 degrees C. That is, to maintain 50 degrees C during analysis, the instrument's internal temperature must be above 25 degrees C; to

maintain 40 degrees C. it must be above 15 degrees C. The printed analysis information is the internal temperature of the instrument, not the oven temperature. Use this to estimate the desired oven temperature.

Instructions for installing the column oven can be found in Chapter 7 of the manufacturer's manual.

VII. Use of the Instrument

There are several step-by-step exercises in Chapter 4 of the manual including set-up of the instrument, obtaining a status report and setting up the plotter.

VIII. Making an Injection

The instrument will accept manually injected samples by reprogramming the CYCLE and EVENT keys. For example, by using the CYCLE key, the user can program the analysis of the injected sample to run for 600 seconds, and to begin 10 seconds from the time of injection. Always enter zero when the LCD displays CYCLE TIME MIN: in order to disable the cycling feature (see example 10, p. 4-17). Use the GAIN and arrow keys to select a GAIN of between 2 and 20, depending on sample/peak resolution. This sets the detector sensitivity for samples less than 100 ul.

To start the analysis of a sample, press ENTER. At the hum of the GC pump, guide the syringe through manual injection port #1 until the needle feels resistance at the touch of the rubber septum. The moment the 2-second buzzer sounds, push the needle through the septum until the barrel hits the injection port, and immediately push the plunger to inject the sample.

IX. Calibration Techniques

Injection of samples should be made using a glass gastight syringe. Sample containers can be glass vessels with stopcocks and septum ports or Teflon or Tedlar gas bags with septum ports.

X. Making Standards

After flushing a gas syringe several times with clean air, inject a known volume of air into the GC. This is called a syringe blank. If the instrument is free from contamination peaks, continue with calibration; otherwise, the syringe needs further cleaning.

To make a standard, first flush a large gas syringe with clean air and fill a clean gas bag with 1 liter of air. Inject a 10 ul sample of pure standard into this 1 liter air bag to produce a 10 ppm standard. To make a 10 ppb standard, inject 1 ml of this 10 ppm standard into another gas bag containing 1 liter of air. Exercise 8 on pages 4-15 through 4-16 demonstrates performing calibration techniques and updating retention times.

XI. Headspace Standards

For vapors, the procedure for preparing standards is by extracting headspace from above a liquid at a known temperature and vapor pressure. The general formula for preparing a standard from the headspace above a volatile liquid is: $v = 760 / P_v (C) (V)$, where v =volume of headspace required (ul), P_v =vapor pressure of liquid (mmHg), C =desired standard concentration (ppm) and V =volume of standard vessel (L). The exercise for performing this procedure can be found on pages 8-5 and 8-6.

XII. Documentation

The following information must be recorded in the instrument calibration and test log and possibly in the site specific logbook for calibration:

1. Instrument name and model
2. ID or serial number
3. Date and time of calibration
4. Method of calibration
5. Identification of calibration standards and volumes
6. Results of calibration (blanks & chromatograms)
7. Name of calibrator

XIII. Routine Maintenance

Fill the internal reservoir with a carrier gas prior to each use in the field (pages 10-1 to 10-3 in manual).

Replace septum as needed. A worn septum will cause leakage and poor replication of results. The type of septum recommended is composed of silicone rubber with its Teflon face mounted downward in the injection port (p. 10-3).

By maintaining the capillary column, the Isothermal GC column oven eliminates retention time drift. Column care and replacement instructions can be found on pages 7-1 to 7-2. This GC operates with a CSP-20 column.

A spare roll of printer/plotter paper and pens should be available for replacement at all times (pages 10-4 to 10-5).

The GC uses a single 12v, 6 AMP/Hr. rechargeable lead/acid battery which should give at least 8 hours of continuous operation. To recharge, connect the unit to an ac source and press ON. Allow the battery to charge overnight (at least 10 hours). Be sure that during charging the carrier gas flow is maintained; otherwise, the ozone generated by the UV source may damage the column packing.

XIV. Troubleshooting

The base of technology for the GC is the 1/2 inch x 1/4 inch UV source. Replacement is recommended on a yearly basis; although, it is advisable to check proper performance with each use. The POWER value should lie between 20 and 50 units. If after three minutes of turning the instrument ON the LCD indicates LAMP NOT

READY, the UV source needs tuning. See pages 11-3 to 11-4 for lamp tuning and replacement.

If the printer does not function properly, try depressing the FEED key to release it.

If the plotter starts then stops immediately, the analysis time may be set at zero. Set proper analysis time using the CYCLE key.

If no peaks appear on printout due to improper valve setting, check settings by pressing TEST then ENTER. If due to leaky gas fittings, hand-tighten all fittings. DO NOT OVERTIGHTEN. Also, the septum in the injection port may need tightening or replacing.

If a peak appears but is not recognized by the detector, it is possible the peak was not calibrated. Perform a qualitative calibration as described in Chapter 4, Exercise 8. Also, make sure the proper identification and plotter numbers have been incorporated into the library.

If peaks appear too slowly or too quickly, check the flow rates. If the instrument uses carrier gas too fast, the flow rate may be too high or there may be a leak. Check the flow rate and tighten all fittings.

If the battery life is too short, the lamp power may be too high. Obtain a status report by pressing TEST then ENTER. If the SOURCE POWER is greater than 50, see corrective procedure #1 on page 11-3 of the manual.

XV. Appendices

For reference, Appendices I, II, III and VI supply useful information regarding the calculation of baseline and peak areas and the identification of retention times, support equipment and keys on the GC panel.

Headspace Analysis for VOCs in Soil

FSOP: 15.02

Date: April 1, 1997

Revision #: _____

Approved by: _____

Page 1 of 2

A. Application

This field screening technique is used to obtain estimated real-time data to aid in determining which samples will be submitted to a contracted laboratory for analyses. This technique helps to minimize the number of samples submitted to the laboratory, and, subsequently, the cost of laboratory analyses.

B. Limitations

Inconsistent sample screening techniques and weather conditions, i.e. temperature and humidity, may yield inconsistent results.

If false positive or false negative results are obtained during sample screening, non-representative samples could be submitted to the laboratory in error or representative samples could be discarded in error.

C. Safety

Refer to site specific Health and Safety Plan

D. Equipment Composition

E. Checklist

Sample Bottles
Aluminum Foil
Photoionization Detector
Logbook

F. Procedures

1. Fill sample screening bottle half full with sample to be analyzed by photoionization detector. At the same time, fill sample bottles for laboratory submission, in case this sample will be selected for analyses by a contracted laboratory.
2. Cover mouth of sample screening bottle with aluminum foil, and screw bottle lid over the foil.
3. Allow all samples to equilibrate at a constant temperature and for an equal amount of time.
4. After equilibration, unscrew the bottle lid, and poke the detector tube of the photoionization detector through the aluminum foil,

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and obtain a reading.

5. Record the reading in a logbook.
6. Based on the readings obtained from sample screening, select samples for submission to a contracted laboratory.

**ASP-1 Analog Smart Portable
Radiation Meter**

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Date: April 1, 1997
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Page 1 of 10

A. Application

Action Levels: Normal background for ionizing radiation is 10-20 counts per minute (CPM) for the HP260 probe and 0.01- 0.02 milliroentgens per hour (mR/h) for the HP270 probe.

*If detection is greater than 1 mR/h, then evacuate the area.
"Normal background exposure rate for gamma radiation is approximately 0.01-0.02 mR/h. Work may continue with elevated radiation exposure rates; however, if the exposure rate increases to 3-5 times above gamma background, a qualified health physicist should be consulted." USEPA Standard Operating Safety Guide.

Operating temperature: -40 degrees F to 122 degrees F (-40 degrees C to 50 degrees C). For operation below 0 degrees F (-18 degrees C), alkaline or nickel-cadmium batteries should be used.

Input sensitivity: adjustable from 1mV to 50 mV.

B. Limitations

1. **Response time, Rate function:** Meter response time is determined by the microcomputer based on input count rate. In the FAST position of the response switch, a maximum 5% standard deviation (SD) is maintained at count rates above 2500 CPM. Response time limits of 1-10 seconds are normal when operating in the FAST position. Decreases in count rate increase percent SD. To improve reading precision at low count rates, a longer response time of 29 seconds can be initiated by selecting the SLOW position of the response switch. This allows the SD to be maintained at 3% or better for a response time of up to 29 sec.
2. **Linearity:** Electronics and meter are plus/minus 3% of full scale. When properly calibrated, the typical maximum nonlinearity due to detector dead time is plus/minus 20% of the reading when operating below the point where the microcomputer determines an overrange condition and gives an alarm. Dead time, or detector resolving time, indicates pulses that occur when the detector is recovering from the previous pulse.

C. Safety

This instrument is not intrinsically safe.

The high voltage power supply is capable of supplying 2500V to the detector connector, and the energy stored in the filter capacitors may produce a hazardous shock. The voltage reduces slowly when the

instrument is turned off. BE CAREFUL.

Do not touch the high voltage circuitry at the front of the circuit board. The circuitry employs CMOS technology and is subject to damage from electrostatic discharge when the bottom can is removed.

The high voltage should be set to the nominal operating voltage or less before connecting a chosen detector to the instrument to prevent damage to the detector.

D. Equipment Composition

Not intrinsically safe.

E. Checklist

ASP-1 Radiation Meter complete with microcomputer and battery pack
HP260 Beta detection probe calibrated specific to instrument
HP270 Beta-Gamma detection probe calibrated to instrument
Detector Cable
Headset
Sheet of rate units labels (from manual)

F. Procedures

I. Operation

This meter is a computer-based, portable, radiation-measuring instrument designed to detect alpha, beta, gamma, x-ray and neutron radiation. This particular instrument has been calibrated to the beta and beta-gamma detector probes. NOTE: Each probe to be used must be calibrated to "its" instrument. The beta probe (HP260) detects in CPM, and the beta-gamma probe (HP270) detects in mR/h.

The upper scale of the meter face displays 0 to 1.0 markings to represent the radiation being measured in changeable units (mR/h, CPM, etc.), depending on the detection desired and probe chosen. The lower scale ranges from 0 to 2500V, indicating the high voltage applied to the chosen detector.

II. External Controls

Operating mode is such that the instrument continually computes the detector pulse rate.

1. **Range Switch:** The nine-position rotary switch, or range switch, is used to turn on the instrument, check the batteries, check the high voltage and select a range of operation. The

computer sets in new, exact calibration factors when the range switch is moved.

- a. **Check battery:** The BAT position of the range switch checks the battery position. Six C-cell batteries are used. The life of six carbon-zinc batteries is from 150 to 250 hours, depending on the high voltage power required, headset usage and light usage. Alkaline batteries will last more than twice as long under the same operating conditions.
- b. **High voltage:** The HV position adjusts the voltage at the detector connector from 300 to 2500 vdc with no load connected and up to 1600v with a 100 Megohm load connected.
- c. **Range of operation:** The circular multiplier dial around the range switch has eleven multipliers (X.001 through X10M in decade steps), six of which are visible at any one time. These are selected according to the units (mSv, R, rem, counts, etc.), the unit time (per sec, per min, per hour) and the sensitivity (pulses per roentgen, etc.) of the detector to be used.

When operating on the three higher range switch settings, a fast response time is maintained, made possible by the higher incoming count rates.

2. **Response Switch:** When the response switch is set at SLOW or FAST, the meter displays the count rate in appropriate calibrated units (mR/h, CPM, etc.). In the FAST position, the response time is selected by the computer for typical survey work. When the SLOW position is selected, the response time is made longer for a steadier reading. Integrated count is also computed from the detector when INTEGRATE is selected, displaying the total radiation received (also in mR/h, CPM, etc.) since the last time it was reset to zero (or since the instrument was turned on if it has not been reset). The maximum integrated reading is full scale on the highest range setting.
3. **Light-Reset Switch:** This triple-function switch is spring-loaded to return to the center (OFF) position. When it is held in the LIGHT position, the meter is lighted. When operating in the rate mode (SLOW or FAST), momentarily pressing the reset switch will drop the meter toward zero. If the switch is held in the RESET position, the meter will go to zero and remain until the switch is released. (If in the FAST or SLOW position and the reset switch is held for five seconds, the meter will

indicate the "standard" current.)

The integrated count will not be zeroed when in a rate mode. If the integrate mode is in use, pressing the reset switch will set the integrated count to zero. A new integrate period begins when the reset switch is released.

4. **Speaker Switch:** When ON, the detector pulses are heard on the speaker, either at full rate or divided down according to the setting of the count down switches. When OFF is selected, the detector pulses are stopped; but, if the computer senses a detector overrange condition, the alarm tone will be heard.
5. **Overrange Indication:** When the radiation rate exceeds the useful range of the detectors, the computer will cause an overrange alarm. At alarm, the meter needle will sweep back and forth across the meter face and an interrupted tone will sound in the speaker. To end the alarm, reduce the radiation at the detector, then move the range switch to OFF and back ON.
6. **Detector Connector:** MHV series coaxial connector is to connect to an external detector/probe.
7. **Detector Dead-Time Range:** This range is set by switches from 0 to 254 microseconds (us) in steps of 2 us.

III. Internal Controls

1. **HV ADJ:** This control adjusts the detector high voltage.
2. **HV CAL:** This control is used to calibrate the meter reading when the HV position of the range switch is selected. HV CAL adjusts the meter to read the actual high voltage value.
3. **5V:** This control is used to set the output of voltage regulator A101 to 5 volts.
4. **CAL:** This control is used to calibrate the meter reading to agree with the input from the detector. The CAL potentiometer provides the fine control while the two CAL switches provide the coarse control. See CAL switches below.
5. **Thresh and Gain:** These controls work together to determine how large a pulse is required from the detector in order to be counted. The normal minimum pulse-height range is from 1 to 50 mV.
6. **Dead-Time Switches:** These seven switches, marked 2, 4, 8,

16, 32, 64, 128 microseconds, are additive and are set (open or closed) to correspond to the resolving (dead) time of the detector being used. The computer uses these settings to correct for lost pulses that would have occurred had the detector been fully recovered from the previous pulse.

7. **Time Switches:** These switches, labeled MIN and HOUR, are set (open or closed) according to the basic time used in the rate mode (per sec, per min, per hour). They affect the calibration of the integrate function but have no effect on the rate mode. (When neither switch is set, per second is assumed. When both switches are closed, the computer will indicate the error by sweeping the meter needle back and forth when in the integrate mode.)
8. **Test Switch:** This switch permits automatic testing of the instrument functions by outside testing equipment. The switch must always be in the closed position for the instrument to operate.
9. **CAL Switches:** These two switches are used in conjunction with the CAL potentiometer to make the meter reading agree with the detector input. When CAL switch "3" is closed, a 1.78 times boost is provided and switch "4" gives a 3.15 times boost. Used together, they multiply to provide a 5.6 times boost in meter reading.
10. **Speaker Rate Div Switches:** These four switches are used to reduce the speaker rate to provide a more meaningful sound from the speaker when the detector count rate is high. They are closed singly to divide the rate by 1, 16, 64 or 256.

IV. Change of Detectors

Several types of detectors may be used with this instrument. They are powered by the positive output of the high voltage power supply. When a radiation reaction occurs, a negative polarity pulse is impressed back on the high voltage line, and the capacitor carries the signal to the amplifier.

The calibration record label in the instrument "can" is a convenient location for calibration information used when changing detectors/probes. The instrument has a "standard" current feature which permits precise resetting of the CAL potentiometer control. "Standard" current is obtained by selecting any range multiplier position, selecting SLOW or FAST and then holding RESET for more than 5 seconds. The meter reading obtained is dependent only upon the CAL control setting, and this feature allows precise resetting of the CAL control.

V. Procedure for Change of Detectors; Circuit Board Adjustments

1. Set range switch to OFF.
2. Disconnect existing detector, if any, from the instrument.
3. Instal new rate units label, if necessary. A screwdriver will be needed to do so. A sheet of labels is included in the manual.
4. If different range switch multipliers are needed, remove one battery so the range switch can be removed without turning the instrument on. Remove the knob, remove the switch nut, and rotate the multiplier plate so that the proper multipliers appear in the window. Reinstall the nut and knob. Set the switch to OFF and reinstall the battery. A 5/64 hex wrench and a 9/16 wrench are needed for this adjustment.
5. Set the dead-time switches to the recorded value in microseconds (found in instrument can).
6. Set the MIN and HOUR switches that affect the calibration of the integrate function (indicated in instrument can; C=Close, O=Open).
7. Set CAL SW 3 and 4 to the recorded settings (values found in instrument can).
8. Close only one speaker rate divider switch, as desired.
9. Select the HV position on the range switch. Adjust the HV ADJ control for the recorded value of high voltage as read on the meter (also found in instrument can). A small adjustment screwdriver will be necessary.
10. Select any range multiplier setting. Select SLOW or FAST and hold RESET for more than 5 seconds. Adjust the CAL control until the meter reads the recorded "standard" current value (never less than 0.42 and also found in the instrument can).
11. If a change in input sensitivity is called for, refer to section IV.C.2.b, p.14 of the user's manual.
12. Connect the new detector.

VI. Using the Instrument

1. After Calibrating the instrument with the detector to be used and checking that the units (label displayed above meter face) and high voltage are correct for the detector, connect the probe to the instrument.
2. Set the range switch to the BAT position. The batteries are adequate if the meter shows above the BAT OK mark. Recheck batteries during long periods of operation.
3. Select the HV position on the range switch. The lower meter scale shows the voltage applied to the detector.
4. For rate measurements, set the response switch to FAST. Set the range switch to the desired range and read the detector response on the upper meter scale. The full scale value is the same as the range switch multiplier number. At low count rates, the needle will fluctuate due to the random nature of radiation emission and detection. When the reset switch is pressed, the reading drops toward zero until the switch is released.
5. When the instrument is on, it is continually integrating the detector counts. To display the present total (in radiation units), select the INTEGRATE position of the response switch and set the range switch for an on-scale reading. The radiation unit for integration is the same as that for the rate mode. (If mR/h is the rate unit, mR is the integration unit, etc.)
6. To begin a new integration period, press the reset switch while in the INTEGRATE position of the response switch. The new integration period begins from zero when the reset switch is released. (A rate mode, SLOW or FAST, may then be selected to prevent accidental loss of the integrated count. The reset switch has no effect on integration when operating in the rate mode.)
7. To use the headset, plug it into the phone adapter.
8. **NOTE:** The overrange alarm may occur at any point on the meter face, not necessarily at a full scale reading.

VII. Calibration Procedure

After following recalibration procedures (choose proper detector, rate units, range switch multipliers), calibration to exposure source must be performed. This procedure will demonstrate

detector efficiency relative to chosen source and source size.

Each source has a known unit of activity which is the number of nuclear transformations occurring in a given quantity of material (the source) per unit time. The unit of measure for this activity is the Curie (Ci) which equals exactly 3.7×10^{10} nuclear disintegrations per second (dps). The source itself is in microcuries (uCi). To calculate the source activity in dps, use the formula $(X)uCi \times 1Ci/10^6uCi \times 3.7 \times 10^{10}dps$.

Document the background reading, source I.D. and source size. Expose detector to known source and document the meter reading's maximum response over a 30 second interval. To calculate the percentage of detector efficiency, simply divide the meter reading by the source activity and multiply by 100.

VIII. Documentation

The following information must be recorded in the instrument calibration and test log and possibly in the site specific log book for calibration:

1. Instrument name and model
2. ID or serial number
3. Date and time of calibration
4. Method of calibration
5. Results of calibration (background & subsequent readings)
6. Identification of calibration source and source size
7. Name of calibrator

IX. Maintenance and Calibration Schedule

Perform routine calibration prior to each use.

Initiate factory checkout and calibration on a yearly basis or when malfunctioning occurs (if troubleshooting fails).

The instrument should be kept as clean and dry as possible.

The batteries should be removed if the instrument is to be unused for an extended period of time.

X. Battery Replacement

1. Set the range switch to OFF.
2. Remove the bottom case.
3. Remove the old batteries.
4. Install three new batteries with the positive ends inside the red cups. Install the other three batteries with their positive ends against the negative ends of the first three.
5. Replace the bottom case.

XI. Troubleshooting

1. **Symptom:** *High voltage output unstable* - It is possible there is high voltage leakage or component breakdown. Check the detector and detector cable. Clean HV components, circuit board and MHV connector. May need to replace faulty component.
2. **Symptom:** *High voltage okay, +5V okay, "standard" current okay, no speaker click, no count rate showing on meter* - Possible faults could be there is no signal through the amplifier and discriminator; the detector could be faulty, may need to replace the detector; detector cable could be open, may need to replace the cable; if nothing is plugged into PHA socket, plug in PHA board or shorting header.
3. **Symptom:** *Only the speaker is dead* - May need to replace the speaker. If more than one speaker rate divider switch is closed, close one only.
4. **Symptom:** *Meter lamps inoperative* - If either lamp is open, may need to replace.
5. **Symptom:** *Speaker okay, high voltage okay, meter never comes off zero during any position of the rotary switch* - May need to replace the meter, the rotary switch or the contact in the detector connector.
6. **Symptom:** *Speaker ON/OFF inoperative or LIGHT-RESET inoperative or INTEGRATE-FAST-SLOW inoperative* - If assembled improperly, the switch leads may be missing mating sockets.

7. **Symptom:** *High voltage output and +5V okay but meter and speaker dead - The detector connector may be unplugged.*
8. **Symptom:** *Battery okay, high voltage okay, speaker okay, instrument inoperative on all range multiplier positions - Try closing the test switch and turning the instrument off and back on.*
9. **Symptom:** *Meter oscillates on integration position - Both time switches may be closed. Close one or none, based on calibration procedures found in instrument can.*
10. **Symptom:** *High count rate occurs constantly on speaker and meter - May need to replace the detector or cable. It is possible the threshold control is fully counterclockwise. If so, reset the threshold potentiometer. The high voltage may need properly reset if too high. It may also be that the high voltage is arcing. If so, see symptom #1.*

*For more in-depth troubleshooting, see User's Manual, section IV, pp. 20-22.

**Eberline Instruments Alarming Pocket
Dosimeter DD-300M**

FSOP: 15.04

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Revision #: _____

Approved by: _____

Page 1 of 2

A. Application

The alarming pocket dosimeter is an electronic device about the size of a pager that will audibly self alarm on exposure to a preset amount of radiation. It will also provide a readout of the accumulated dose. The dosimeter is to be worn by field staff investigating closed or abandoned sites so that elevated levels of radioactivity may be detected.

B. Limitations

The alarming pocket dosimeter is not meant at this time to take the place of film badges or thermoluminescent detectors worn as part of a regular occupational exposure. It may augment, but not replace other dosimetry described in a site safety and health plan.

C. Safety

Before use of an Alarming pocket dosimeter be sure to read and understand the manufacturer's instruction booklet for the device. For the Eberline DD-300M this is a 5 part fold out wallet card that should be clipped to the dosimeter between uses. Always refer to the site-specific safety plan when using this device.

For general background dosimetry a gamma detection instrument is most appropriate. Gamma is the most penetrating and the most common radiation, being a secondary emission for most Beta and Alpha decays.

D. Equipment Composition

N/A

E. Checklist

Note: When recording information, please use micro instead of u (μ) and milli instead of m as a prefix. There have been several false alarms requiring the dispatch of a radiological survey team because of mix ups in transcriptions or misuse of the single character abbreviations.

F. Procedures

1. Turn the dosimeter on by pressing the red button for not more than two seconds. Check the display to be sure the dose reads zero. (0.00)
2. If a dose is registered in the left-most group of display numbers, **clear the dose** by pressing the red button until "OFF" shows in the display (Hold button down for about five seconds.) Release button and wait five seconds. Press the red button again and hold down until the display comes on and changes to all zeros. Release button.

3. When done with the site survey or other work requiring the dosimeter, record any dose the device registered for you and communicate this with the site coordinator. If any dose was recorded the site coordinator will communicate this with a health physicist for interpretation. Turn the unit off by pressing the red button until "OFF" shows in the display, release the button.
4. If at any time the alarm sounds immediately check the dose rate and move out of the area. Record the dose rate and location with the site coordinator along with any accumulated dose you may have received. The site coordinator will communicate these readings and other information collected on the site to a health physicist for interpretation and possible action by a radiation survey team.

G. Set-up Procedures

N/A

H. Calibration Procedures

It is not practical to field calibrate this unit. The calibration procedures require an electronics lab and a test range. The calibration date is located on the side of the unit for reference.

I. Documentation

"Normal background exposure rate for gamma radiation is approximately 0.01 to 0.02 milliR/hr (10 to 20 microR/hr). Work may continue with elevated radiation exposure rates. However, if the exposure rate increases to 3 to 5 times above the gamma background, a qualified health physicist should be consulted." USEPA Standard Operating Safety Guide.

If readings of 3 to 5 times background gamma are encountered work does not need to stop, but a note needs to be made to contact a Health Physicist on return to the office. Some interpretive guidance is available from the DERR-CEPU Radiation Safety Program at 614-644-3066.

The Memorandum of Understanding between OEPA and ODH designates ODH as the supplier of Health Physicists for field surveys. The number of the ODH Radiological Safety Bureau is 614-644-2727. Ask for the Radioactive Materials Unit.

J. Routine Maintenance

No field maintenance is possible for this unit other than surface cleaning and decontamination.

Decontamination of Sampling Equipment

A. Application

Decontamination procedures are used on equipment to avoid cross contamination. Equipment cleaned in the laboratory, or disposable equipment is preferred over decontamination in the field.

If decontaminating in the lab, a gross decontamination in the field (i.e. rinse off all soil, muck, sludge, etc.) should be stress to avoid bringing an unnecessary amount of contamination into the lab area.

Two methods are employed depending on whether contaminants of interest are organic or inorganic.

B. Limitations

Solvents and acids may deteriorate the equipment if they are not compatible.

A rinsate blank must be run on the sampling equipment to determine if there is any contamination remaining. The rinsate blank should be taken at the request of the field team leader at an undisclosed time so that bias is not introduced into decontamination procedures.

Consider the cost of disposable equipment versus the cost of cleaning solutions, staff time, and rinsate blank analysis.

C. Safety

Proper Protection is required while decontaminating to avoid contact with solvents and contamination. This includes safety goggles or glasses, plastic aprons, and gloves. Solvent and acids can act as transport mechanisms for contaminants. Do not splash liquids and do not create aerosol.

D. Equipment Composition

Brushes and decontamination pans or tubs should be selected relative to their inertness when possible

The preferred sampling equipment is disposable or relatively inert such as Teflon or stainless steel. Although Teflon is preferred for its inertness, the disadvantage to using this material is that it is so soft and is easily scratched. The grooves from scratches are difficult to clean and may easily trap contaminants.

E. Checklist

Decontamination tubs/pans
Brushes

Non-phosphate detergent

ASTM Water

Solvents

Waste solvent can

F. Procedures

I. Laboratory Decontamination

1. A gross decontamination in the field should be conducted prior to lab decontamination.
2. Wash the equipment with tap water and a non-phosphate detergent. If disassembly of equipment is necessary, disassemble before cleaning.
4. Rinse with tap water.
5. Rinse with ASTM Type II Water.
6. Rinse with the appropriate solvents (see section III).

II. Field Decontamination

grass or
recommended
layer of

1. Set-up equipment decontamination in an area upwind from activities which might contribute dust or other contaminants to the decontamination solutions. Also, do not allow tall weeds to lean into decontamination solutions. It is to set up the decontamination procedures on a polyethylene sheeting.
2. If the equipment has a lot of soil or sludge or other contaminants on it, a prewash with tap water and nonphosphate detergent or just tap water is recommended.
3. Wash the equipment with tap water and a non-phosphate detergent. If disassembly of equipment is necessary, disassemble before cleaning.
4. Rinse with tap water.
5. Rinse with ASTM Type II Water.
6. Rinse with the appropriate solvents (see section III).
7. If the equipment is not to be used immediately, it must be wrapped in Aluminum foil.

III. Solvent Rinses

Inorganic Method

may 1. Rinse with dilute (10%) hydrochloric acid (HCL) or nitric acid (HNO3). Dilute HCL is preferred because dilute HNO3 oxidize stainless steel.

2. Rinse liberally with tap water.

3. Rinse liberally with ASTM Type II water or equivalent.

Organic Method

1. Rinse liberally with ASTM Type II water or equivalent.

2. Rinse with pesticide grade methanol.

3. Rinse with pesticide grade hexane.

4. Thoroughly dry and wrap in aluminum foil.

Organic and Inorganic Method

1. Rinse with dilute (10%) hydrochloric acid (HCL) or nitric acid (HNO3). Dilute HCL is preferred because dilute HNO3 may oxidize stainless steel.

2. Rinse liberally with tap water.

3. Rinse liberally with ASTM Type II water or equivalent.

4. Rinse with pesticide grade methanol.

5. Rinse with pesticide grade hexane.

6. Thoroughly dry before using or rinse liberally with ASTM Type II water.

7. Thoroughly dry and wrap in aluminum foil.

**Geoprobe™ Procedures for Collection
of Soil and Ground Water Samples**

FSOP: 17.01
Date: April 1, 1997
Revision #: 0
Approved by: _____

Page 1 of 9

A. Application

The Geoprobe Model 5400 is a hydraulically powered, truck-mounted percussion driven subsurface sampling device capable of collecting subsurface soil samples (continuous core or discrete depth samples) and in situ ground water samples. The information obtained from a Geoprobe investigation can be used to define the limits of subsurface contaminant investigations and assist in determining placement of monitoring wells.

B. Limitations

In dry loose soil, the Geoprobe can penetrate much further than in tightly bound clay; however, it is not recommended for use in rocky soils or tightly compacted glacial till deposits. Other subsurface investigation methods should be considered for sampling consolidated deposits. Use of the Geoprobe in these situations may result in either damage to the unit or possible injury.

C. Safety

Ensure that all overhead and buried utilities (i.e., electrical lines, telephone lines, gas lines, fiber optic lines, etc.) have been identified and located prior to commencing the subsurface investigation.

Call B-4-U Dig @ 1-800-362-2764

Operators should wear OSHA-approved steel-toed shoes and keep feet clear of probe foot.

Operators should wear OSHA-approved safety glasses.

Operators must wear hearing protection (OSHA-approved for levels exceeding 85 dB is recommended).

Only one person should operate the Geoprobe at one time.

Never place hands on top of the probe rod while the rod is under probing machine.

Turn off the hydraulic system at the control panel while changing probe rods, inserting the hammer anvil, or attaching any accessories.

Never exert downward pressure on the probe rod so as to lift the probe foot over six inches off the ground.

Always take the Geoprobe carrier vehicle out of gear and set emergency brake before engaging the remote ignition.

Operators must stand to the control side of the probe machine, clear of the probe foot and derrick, while operating the controls.

Never exert down pressure on the probe rod so as to lift the rear tires of the carrier vehicle off the ground.

The vehicle's catalytic converter is hot and may present a fire hazard when operating over dry grass or combustibles.

Shut down the hydraulic system and stop the vehicle before attempting to clean or service the equipment.

Use caution when carrier vehicle is parked on a loose or soft surface. Do not apply enough force to the probe foot to lighten the load on the carrier vehicle suspension. Reduced weight on the vehicle tires may allow the vehicle to shift or slide on the loose surface.

Do not wear loose clothing while operating this machine. Severe injury will result if clothing becomes entangled in moving parts.

Avoid hydraulic fluid leaks. Pressurized fluid may be injected into the skin resulting in serious bodily injury. In the event of an accident, seek medical attention immediately.

In the event of a problem, the operator should release all control levers. The spring-loaded levers will automatically return to the neutral position and machine operation will cease.

Geoprobe machines are equipped with a remote starting system. Ensure that everyone is clear of all moving parts before starting the machine.

Do not make modifications or add attachments to this machine which are not approved by Geoprobe Systems.

D. Equipment Composition

The Geoprobe Model 5400 unit consists of a powered percussion hammer which is slide mounted on a derrick and has a 54 inch stroke. The derrick assembly hydraulically folds and unfolds from the traveling/storage position in the back end of a capped Ford F250 truck. The derrick is also hydraulically adjustable in both the fore and aft directions as well as the angle to insure the derrick is vertical. Manual side to side adjustment can also be made.

The Geoprobe Model 5400 utilizes the weight of the truck and a powered percussion hammer to advance four-foot long rods into the ground. The drive rods are hardened steel with an outside diameter (O.D.) of one inch and an inside diameter (I.D.) of 0.5 inch. The operator controls the hydraulic hammer through the use of levers and the helper assists by adding sections of rod. Depending on the purpose of the investigation, the lead rod will be connected to a specific tool to collect continuous soil cores, discrete depth soil cores or ground water.

The three primary probing tools used to collect environmental subsurface samples are the Macro-Core® soil sampler, the large bore sampler for discrete depth samples, and the screen point sampler for collection of

ground water samples.

E. Checklist

Hearing protection	GW Sampler Sheath
Safety glasses	GW Drive Head
Hard Hat	Wire-Wound Stainless Steel Screen
Logbook	Expendable Drive Points
Leather Gloves	Static Water Level Indicator
Nitrile Disposable Gloves	PVC Grout Plug
Miscellaneous tools	PVC Screen (optional)
4-foot probe rods	Screen Push Adapter
Extension Rods (48")	Casing Puller Kit
Drive Cap	Polyethylene tubing - 3/8" O.D.
Pull Cap	O-ring Service Kit
Macro Core (MC) Drive Head	Large Bore (LB) Sample Tube
MC Sampler Tube	LB Drive Head
MC Cutting Shoe	LB Cutting Shoe
MC Closed Piston System	LB Piston Tip & Rod
MC PETG/PVC Heavy-Duty Liner	LB Piston Stop Pin, w/ O-ring
MC Combination Wrench	LB CAB Clear Plastic Liners
MC Vinyl End Caps	LB Cutting Shoe Wrench
MC Core Catcher (optional)	LB Vinyl End Caps
Decontamination Supplies	Liqui-Nox Soap
Various Brushes	Tap & ASTM Water
Pressurized Sprayer	Wash Tub
Bentonite pellets/granules	Polyethylene Sheeting

F. Procedures

1. Overhead and Buried Utilities

The use of the Geoprobe on a site within the vicinity of electrical power lines and other utilities requires that special precautions be taken by the operators. Determine what the minimum distance from any point on the unit to the nearest power will be when the derrick is raised and/or being raised. **Do not raise the derrick or operate the unit if this distance is less than 25 feet, or if known, the minimum clearance stipulated by federal, state, and local regulations.** In order to avoid contact with power lines, only move the unit with the derrick down. Underground electrical utilities are as dangerous as overhead electricity. Be aware and always suspect the existence of underground utilities.

REMEMBER: Call B-4-U Dig @ 1-800-362-2764

2. Visual Inspection

At the start of each work day, the operator must visually inspect the Geoprobe, which includes: (1) checking the hydraulic fluid levels, and the hydraulic lines for fraying, cuts or leaks; (2) checking the derrick and attachments assembly for adequate grease, and for damage, nicks, burrs, and leaks; (3) removing any unnecessary dust, dirt, or oil to prevent jams or damage to the equipment; (4) checking the nuts and bolts; and (5) checking the

sampling equipment (e.g. drive rods, anvil, pull caps, sampling tools) for damage such as stress cracks, burrs, and bends.

3. **Set-up of the Geoprobe**

Following the visual inspection and routine maintenance, the unit is ready for operation. The following steps describe the set-up procedure for the Geoprobe 5400:

- a. Position the vehicle at the sample location. Park the truck as level as possible; the truck must be level in the side-to-side aspect to drive the rods properly. If on an incline, point the front of the truck upgradient. If possible, face the truck downwind to avoid potential cross contamination from the vehicle's exhaust and to prevent exhaust fumes from entering the work area.
- b. Put the vehicle transmission in **PARK**, set the parking brake, and shut off engine at ignition switch in the truck cab.
- c. Set the Master Control Switch, located on the side of the driver's seat, to the **ON** position.
- d. Open and secure the rear doors with the bungee cords provided so that the wind and/or vibrations will not cause the doors to swing shut into the work area during operation.
- e. If available, attach an exhaust hose to the tailpipe and direct the exhaust downwind, away from the work area.
- f. Ensure that the Hydraulic Speed Control Switch is in the **OFF** position prior to starting the unit. Start the vehicle engine with the remote ignition switch located on the Control Panel.
- g. Place the Hydraulic Speed Control Switch in the **SLOW** position to activate the hydraulic clutch system. Allow the unit to warm-up in this position. This is especially true in colder weather, where the unit should warm-up for approximately 15-20 minutes.
- h. Pull the **EXTEND** control lever toward the rear of the vehicle and laterally extend the probe unit as far as possible. Using the **FOOT** control lever, lower the derrick assembly so that it is below the top of the foot cylinder. This will ensure Clearance at the roof when unfolding the probe.
- i. Pull the **FOLD** control lever down to pivot the probe unit until it is perpendicular to the ground.
- j. At this time, if desired, swing the probe manually by disengaging the swing mount latch lever.

- k. Lift up on the **EXTEND** control to move the probe back toward the vehicle. Stop when the foot cylinder is approximately 8-10 inches from the vehicle bumper.
- l. Push down on the **FOOT** control to extend the foot and put the vehicle weight on the probe unit. Stop when the foot just contacts the ground. It is not necessary to significantly raise the rear of the vehicle.
- m. Lift up on the **PROBE** control and raise the derrick to its maximum height. Check that the derrick is true vertical and adjust as necessary.
- n. Shut off the hydraulics by placing the control switch in the **OFF** position. Assemble the desired lead tool and attach a drive cap to the top of the tool.
- o. Place the lead tool beneath the hammer assembly, and switch the hydraulic control to the **SLOW** position. The lead tool should be centered between the foot supports and parallel with the derrick. Push down on the **PROBE** control to lower the hammer unit on top of the lead tool. Ensure that the drive cap is seated in the anvil. The Geoprobe is now ready to advance the sampler into the ground.

4. **Rod Advancement**

Probing operations often require the simultaneous operation of two hydraulic levers; the **PROBE** control lever and the **HAMMER** control lever. Because of this, probing operations require some manual coordination and practice in order to yield smooth, trouble free operation. Beginners should be given a day of practice in the field with an experienced probe operator before attempting to use a probe machine on an actual site investigation.

To advance the lead sampling tool to the desired project depth, the following procedures should be followed when using the Geoprobe Model 5400.

- a. Make sure the **HAMMER/ROTATION** lever is in the horizontal position.
- b. Screw a drive cap onto the male end of the lead sampling tool or probe rod. **Make sure all threaded parts are completely threaded together before driving. Failure to do so may permanently damage the equipment.**
- c. Position the lead tool in the center of the derrick foot and directly below the hammer anvil. **Positioning of the first tool/rod is critical in order to drive the probe rod vertically. Both the probe rod and derrick must therefore be in a vertical position.**

- d. Many times the probe rods can be advanced using only the static weight of the vehicle. When advancing the first tool/rod, always select **SLOW** on the speed control. To begin probing, activate the hydraulics and push down on the **PROBE** control lever. The lead tool/rod will be slowly pushed into the ground. This procedure allows the operator to gauge the soil resistance and avoid deflection.
- e. In some soil types, the probe rods cannot be advanced by using only the static weight of the vehicle. At the point where the lead tool/rod does not advance and the weight of the vehicle is placed on the rod, move the toggle switch to the **FAST** position. Push down again on the **PROBE** lever and continue to push the lead tool/rod. Allow the rear of the truck to rise 6 inches off the ground. When the weight of the truck is insufficient to push the rod into the ground, push down on the **HAMMER** lever. When the rod has advanced to the point where the derrick foot is again on the ground, release the **HAMMER** lever, push the **PROBE** lever down until the truck again rises 6 inches. Repeat this process until the rod is driven into the ground.

CAUTION: Always keep static pressure on the probe rod (with the **PROBE** lever) or the rod will vibrate and chatter while hammering, causing rod threads to fracture and break.
- f. A good technique for driving probe rods is to hold down on the **HAMMER** control and advance the probe cylinder downward in 2-inch increments with the **PROBE** control.
- g. Periodically, stop hammering and check to see if the prob rods can be advanced with static force only.
- h. As the **HAMMER** control is used to apply percussion to the probe rods, the rods will tend the unscrew slowly. If this happens, the chance of breaking threads is greatly increased. To keep from breaking rods, simply tighten the rods by hand or with a pipe wrench while driving the rods.
- i. Once the lead tool/rod has been driven into the ground, raise the hammer anvil to it's full height by lifting on the **PROBE** lever and turn the hydraulics to the **OFF** position. Never reach into or around the hammer anvil while the hydraulic switch is in the ON position. The helper then removes the drive cap from the lead tool/rod and attache the drive cap to the next rod to be used. The helper then attaches the next 4-foot rod section to the tool/rod that has just been driven.

- j. Now that the Geoprobe 5400 has driven rods to the desired sampling depth, it is ready for the crew to perform the required sampling activities. Depending on the specific method of sampling being performed, refer to the specific Geoprobe sampling FSOP's.

5. **Rod Removal**

Probe rods, once driven to depth and upon completion of desired sampling activities, can also be pulled using the Geoprobe 5400.

- a. Turn off the hydraulics and lift the hammer latch to its raised position, if not already raised.

WARNING: When moving the hammer latch, do not place thumb or fingers between latch and bottom plate of the rotation member.

- b. If not already off, remove (unscrew) the drive cap from the last probe rod which has penetrated the soil.
- c. Screw a pull cap (or use a quick-connect split pull cap) onto the same rod from which the drive cap was just removed.
- d. Turn on (activate) the hydraulic control to **SLOW**.
- e. Hold down on the **PROBE** control and move the probe cylinder down until the latch can be closed over the pull cap.
NOTE: If the latch will not close over the pull cap, adjust the derrick assembly by using the **EXTEND** control. The lateral swing capability may be used to obtain proper side-to-side adjustment. These adjustments will allow centering of the pull cap directly below the hammer latch.
- f. Set the hydraulic control switch to **FAST** and retract the probe rods by pulling up on the **PROBE** control lever.
- g. Once the probe cylinder has reached its uppermost limit, slight push down on the **PROBE** control to lower the cylinder just enough to reduce the tension on the rod and allow the hammer latch to be raised. Raise the hammer latch.
- h. Pull up on the **PROBE** control lever and raise the probe cylinder as high as possible. This will allow enough room for the rods to be unscrewed.
- i. Turn off (deactivate) the hydraulic control switch.
- j. Unscrew the retracted probe rod. Unscrew the pull cap from the retracted rod. Screw the pull cap onto the next rod that is to be pulled.
- k. Continue these steps until all rods are extracted from the hole.

1. At times, the rods may have the tendency to slide back into the hole from which they came. Please be aware of this fact; rods and tools are difficult, if not impossible, to retrieve once lost down a deep hole. Before lifting the hammer latch, ensure that the rods are not sliding back. Should the rods be observed sliding back down the hole, use a pipe wrench or attach vise-grips to the rod to prevent backward movement.

6. **Geoprobe Shutdown**

After the rods have been extracted from the ground, the Geoprobe 5400 is ready to be shutdown and moved to the next sampling location.

- a. Turn on the hydraulics and set the control toggle switch to **SLOW**, push down on the **PROBE** control lever and lower the probe cylinder to the bottom of the derrick.
- b. Lift the **FOOT** control lever to raise the derrick foot a few inches off the ground.
- c. Push the **EXTEND** lever down to ensure that the derrick is fully extended.
- d. Check to make sure that all hydraulic and electrical lines, as well as stray pieces of equipment are clear of the derrick storage area.
- e. Lift the **FOLD** lever to fold the derrick assembly to the horizontal position.
- f. Lift the **FOOT** lever to bring the derrick foot all the way up to its storage position.
- g. Lift the **EXTEND** lever to bring the entire derrick assembly into the truck storage area.
- h. Turn off (deactivate) the hydraulics by placing the toggle switch in the **OFF** position.
- i. Shut off the vehicle engine using the remote ignition switch on the control panel.
- j. Ensure that all hardware and tools are returned to the back of the truck. Secure doors.
- k. Set the Master Control switch, located on the side of the driver's seat to the **OFF** position.

The Geoprobe 5400 is now ready to be moved to the next sampling location.

7. Sampling Procedures

The Ohio EPA, Division of Emergency & Remedial Response (OEPA-DERR) has adopted the Standard Operating Procedures developed by Geoprobe Systems for use in sample collection. These SOP's are in addition to the 5400 Model Geoprobe Operations Manual. For more technical instructions, system or equipment specifications or component information, refer to the 5400 Model Geoprobe Operations Manual.

The following is a list of the Standard Operating Procedures adopted for sampling methodologies with the Geoprobe:

1. For collecting discrete depth soil samples: **Technical Bulletin No. 93-660, "Geoprobe AT-660 Series Large Bore Sampler Standard Operating Procedure";**
2. For collecting continuous four-foot cores: **Technical Bulletin No. 95-8500, "Geoprobe Macro-Core® Soil Sampler Standard Operating Procedure";**
3. For collecting ground water samples: **Technical Bulletin No. 95-1500, "Geoprobe Screen Point 15 Ground Water Sampler Standard Operating Procedure."**

SECTION 17.01

ATTACHMENT A

**GEOPROBE SCREEN POINT 15
GROUNDWATER SAMPLER**

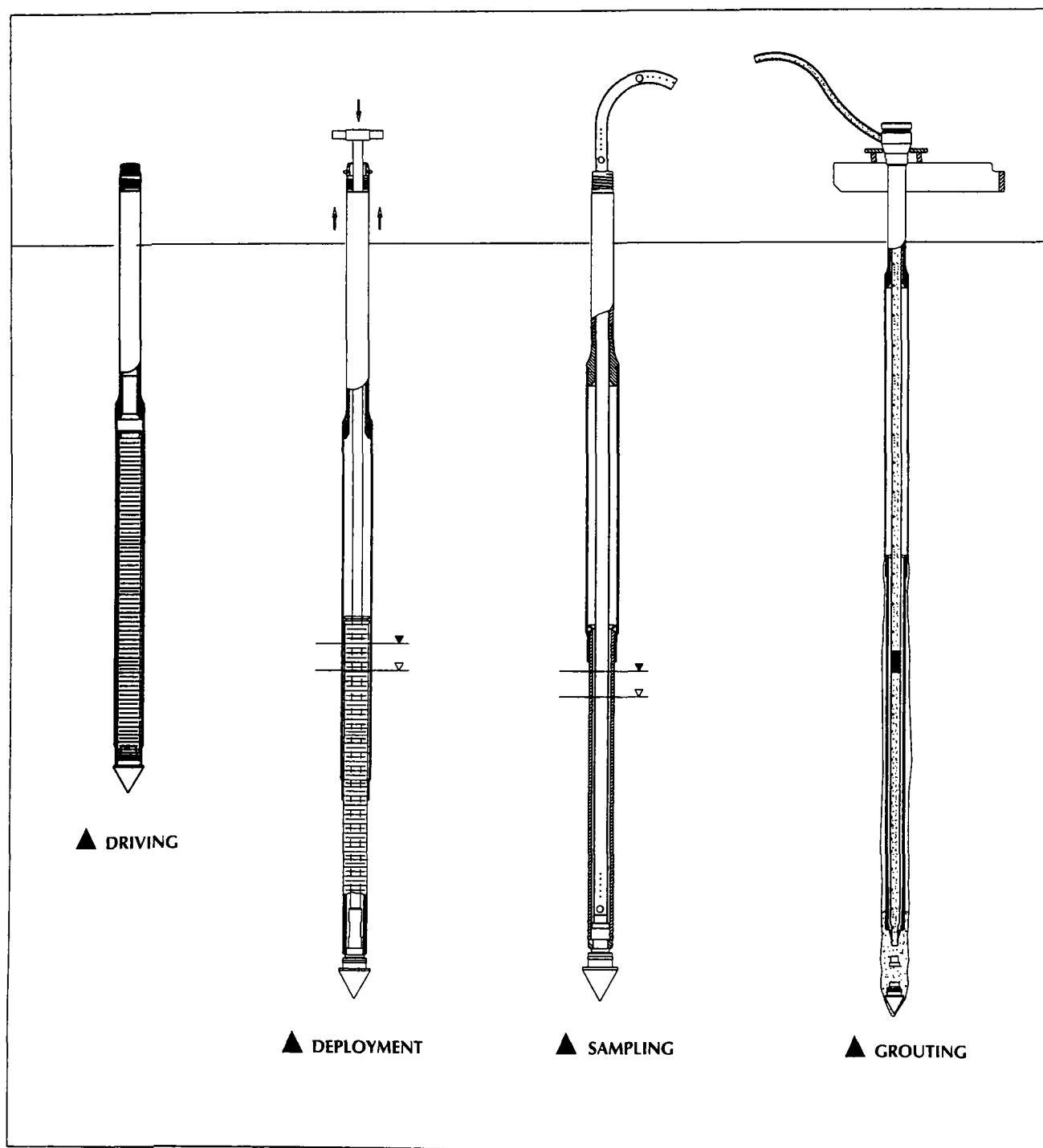
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GEOPROBE SCREEN POINT 15 GROUNDWATER SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 95-1500

PREPARED: October, 1995



GEOPROBE SCREEN POINT 15 GROUNDWATER SAMPLER

1.0 OBJECTIVE

The objective of this procedure is to drive a sealed stainless steel or PVC screen to depth, deploy the screen, obtain a representative water sample from the screen interval, and grout the probe hole during abandonment. The Screen Point 15 Groundwater Sampler enables the operator to conduct abandonment grouting that meets American Society for Testing and Materials (ASTM) Method D 5299-92 requirements for decommissioning wells and borings for environmental activities (ASTM 1993).

2.0 BACKGROUND

2.1 Definitions

Geoprobe*: A vehicle-mounted, hydraulically-powered, soil probing machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

** Geoprobe is a registered trademark of Kejr Engineering, Inc., Salina, Kansas.*

Screen Point 15 Groundwater Sampler: The assembled Screen Point 15 Sampler (GW-1500K) is 1.5 inches (38 mm) O.D. (outside diameter) x 52 inches (1321 mm) overall length. A stainless steel or PVC screen with an exposed screen length of 41 inches (1041 mm) is utilized.

Casing Puller: An assembly which makes it possible to retract the sampler string with extension rods protruding from the top of the probe rods. The casing puller for units originally equipped with the GH-40 hammer consists of the following:

PART NAME/NUMBER	QUANTITY
Casing Pull Bracket Assembly (GW-3337)	(1)
Casing Pull Plate Assembly (GW-468)	(1)
Casing Pull Anchor Assembly (GW-3286)	(1)
Bolt, HHCS 1/2"-13 x 2" GR 5 PLTD	(2)
Lock Washer, 1/2" PLTD	(2)

These items may be obtained separately or as a Casing Pull Kit (GW-4600K).

Units originally equipped with the SK-58 hammer or retrofitted with the GH-40 hammer require a different casing puller kit. Contact Geoprobe Systems for specific information.

2.2 Discussion

In this procedure, the assembled Screen Point 15 Groundwater Sampler (Fig. 2.1A) is threaded onto the leading end of a Geoprobe probe rod and driven into the subsurface with a Geoprobe machine. Additional probe rods are subsequently added and driven until the desired sampling interval is reached. While the sampler is driven to depth, O-ring seals at the drive head and expendable drive point provide a watertight system. This system eliminates the threat of formation fluids entering the screen before deployment and assures sample integrity.

Once at the desired sampling interval, extension rods are sent downhole until the leading rod contacts the bottom of the sampler screen. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods (Fig. 2.1B). As the tool string is retracted, the expendable point is released from the sampler sheath. An O-ring on the screen head maintains the seal at the top of the screen. As a result, any liquid entering the sampler during screen deployment must first pass through the screen. The tool string and sheath may be retracted the full length of the screen or as little as a few inches if a small sampling interval is desired.

The Screen Point 15 Sampler utilizes a screen with a standard slot size of 0.004 inches (0.1 mm) and an exposed length of 41 inches (1041 mm). Alternate slot sizes and lengths may be custom ordered. Contact Geoprobe Systems for available options. The screen is constructed such that a check valve or mini-bailer can be inserted into the screen cavity. This makes direct sampling possible from anywhere within the saturated zone. A removable plug in the lower end of the screen allows the user to grout as the sampler is extracted for further use.

Groundwater samples can be obtained in a number of ways. The most common method utilizes polyethylene or Teflon® tubing and a Tubing Bottom Check Valve (GW-42). The check valve (with check ball) is attached to one end of the tubing and inserted down the casing until it is immersed in groundwater. Water is pumped through the tubing and to the ground surface by oscillating the tubing up and down. Another means of collecting groundwater samples is to attach a peristaltic or vacuum pump to the tubing. This method is limited in that water can be pumped to the surface from a maximum depth of approximately 26 feet (8 m). A final technique for groundwater sampling is to use a stainless steel Mini-Bailer Assembly (GW-41). The mini-bailer is lowered down the inside of the casing below the water level where it fills with water and is then retrieved from the casing.

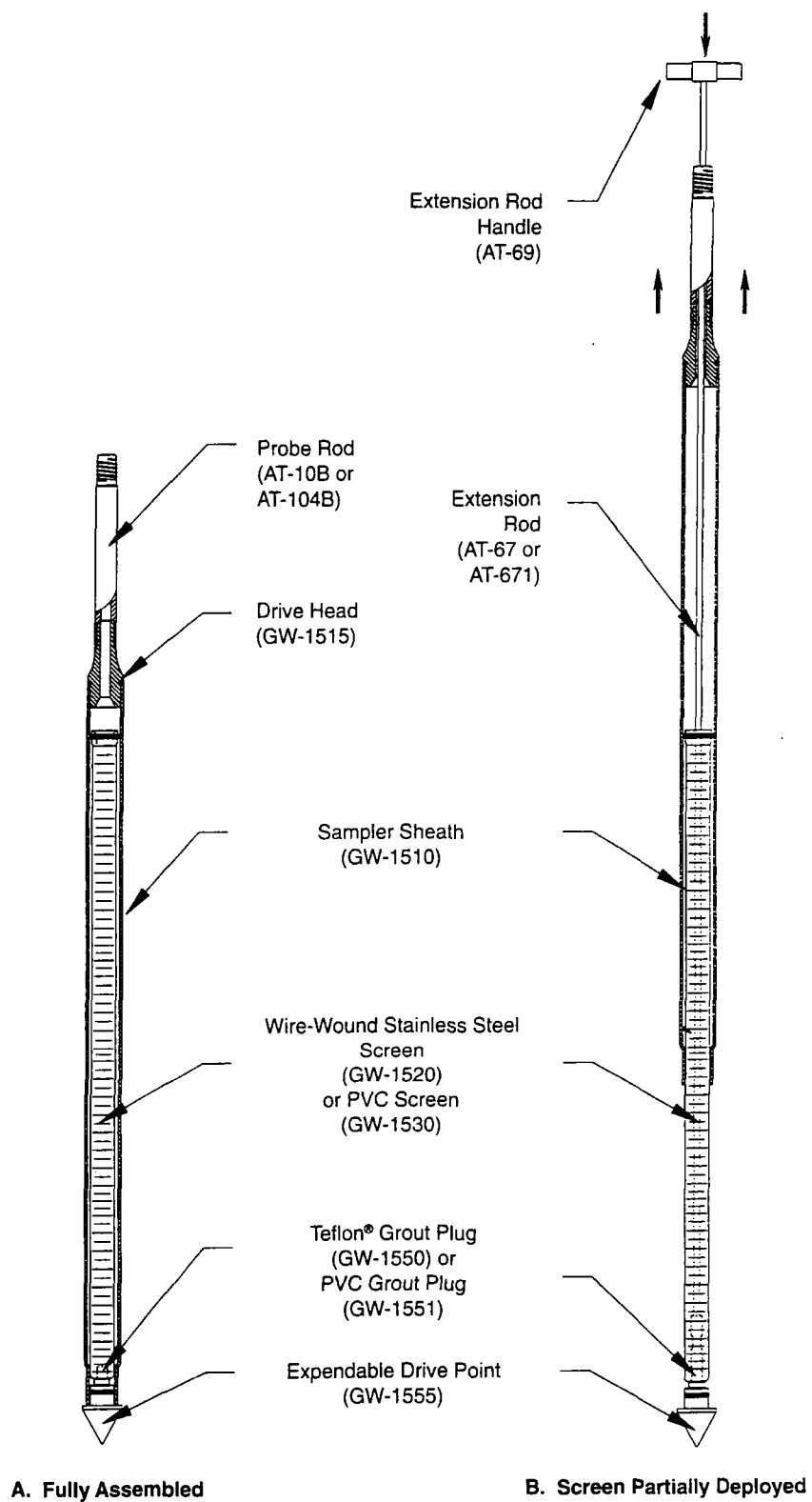


FIGURE 2.1
Screen Point 15 Groundwater Sampler

3.0 REQUIRED EQUIPMENT

The following equipment is required to successfully recover representative groundwater samples with the Geoprobe Screen Point 15 Groundwater Sampler and probing system. See Figure 3.1 for Screen Point 15 parts identification.

Screen Point 15 Groundwater Sampler Parts	Quantity	Part Number
O-ring Service Kit (contains 100 of each O-ring required)	-1-	GW-1504K*
Sampler Sheath	-1-	GW-1510*
Drive Head	-1-	GW-1515*
Wire-Wound Stainless Steel Screen, 4-Slot	-1-	GW-1520*
PVC Screen (optional)	-1-	GW-1530
Screen Push Adapter	-1-	GW-1535*
Grout Plug Push Adapter	-1-	GW-1540*
Grout Plugs, Teflon [®] (Pkg. of 25 plugs)	-1-	GW-1550K
Grout Plugs, PVC (Pkg. of 25 plugs)	-1-	GW-1551K*
Expendable Drive Points (Pkg. of 25 points)	-1-	GW-1555K*
Grout Nozzle	-1-	GW-1545
Casing Puller Kit (for GH-40 hammer)	-1-	GW-4600K

*Denotes part is included in Screen Point 15 Groundwater Sampler Kit (GW-1500K).

Geoprobe Tools	Quantity	Part Number
Probe Rod (36")**	Variable	AT-10B
Probe Rod (48")**	Variable	AT-104B
Drive Cap	-1-	AT-11B
Pull Cap	-1-	AT-12B
Split Pull Cap (Optional)	-1-	AT-113
Extension Rod (36")**	Variable	AT-67
Extension Rod (48")**	Variable	AT-671
Extension Rod Coupler	Variable	AT-68
Extension Rod Handle	-1-	AT-69
Extension Rod Jig	-1-	AT-690
Quick Link Extension Rod Connectors (Optional)	Variable	AT-694K

**Either 36-inch or 48-inch probe rods and extension rods may be used. Both lengths are not required.

Additional Tools	Quantity
Locking Pliers	-1-
Pipe Wrenches	-2-

Note: Replacement parts may be obtained in various kits. Contact Geoprobe Systems for specific packages.

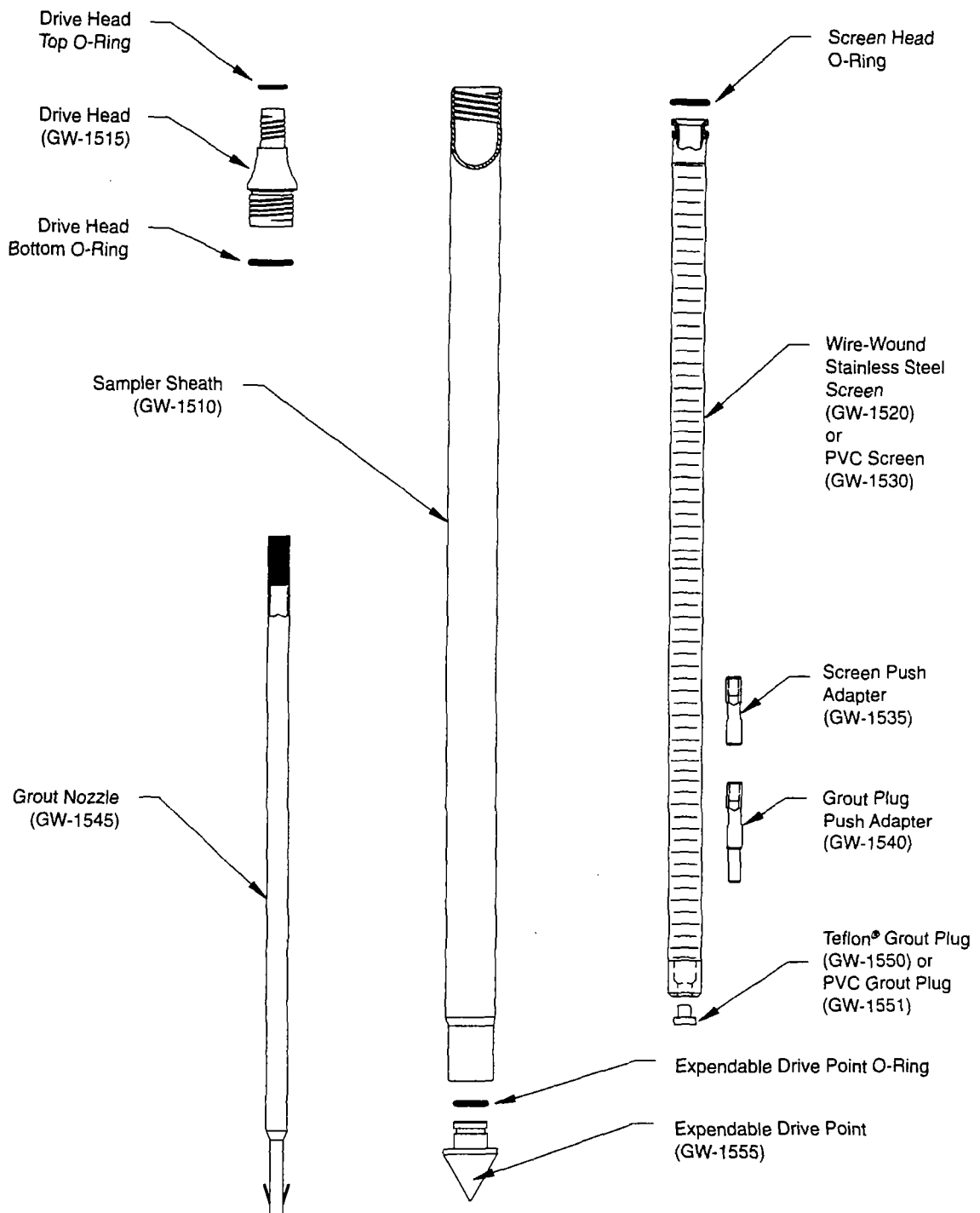


FIGURE 3.1
Screen Point 15 Groundwater Sampler Parts

4.0 OPERATION

4.1 Basic Operation

The Screen Point 15 Groundwater Sampler utilizes a stainless steel or PVC screen which is encased in an alloy steel sampler sheath. An expendable drive point is placed in the lower end of the sheath while a drive head is attached to the top. O-rings on the drive head and expendable point provide a watertight sheath which keeps contaminants out of the system as the sampler is driven to depth. Once the desired sampling interval is reached, extension rods equipped with a screen push adapter are inserted down the inside diameter of the probe rod string. The tool string is then retracted approximately 44 inches (1118 mm) while the screen is held in place with the extension rods. At this point the system is ready for groundwater sampling. When sampling is complete, a removable plug in the bottom of the screen allows for grouting below the sampler as the tool string is retrieved.

4.2 Decontamination

In order to collect representative groundwater samples, all Screen Point 15 parts must be thoroughly cleaned before and after each use. Scrub all metal parts using a stiff, long-bristle brush and a nonphosphate soap solution. Steam cleaning may be substituted for hand-washing if available. Rinse with distilled water and allow to air-dry before assembly.

4.3 Sampler Assembly (Fig. 4.1)

1. Install an O-ring on an expendable drive point (GW-1555). Firmly seat the expendable point in the necked end of a sampler sheath (GW-1510).
2. Place a grout plug (Teflon[®] GW-1550 or PVC GW-1551) in the lower end of a wire-wound stainless steel (GW-1520) or PVC screen (GW-1530). When using the stainless steel screen, install an O-ring in the groove on the upper end of the screen. Slide the screen inside of the sampler sheath with the grout plug toward the bottom of the sampler. Ensure that the expendable point was not displaced by the screen.
3. Install a bottom O-ring on a drive head (GW-1515). Thread the drive head onto the sampler sheath. Attach a drive cap (AT-11B) to the top of the drive head. The drive head and cap must only be hand tight. Tools are not required as long as the attachments completely thread together.
4. Sampler assembly is complete.

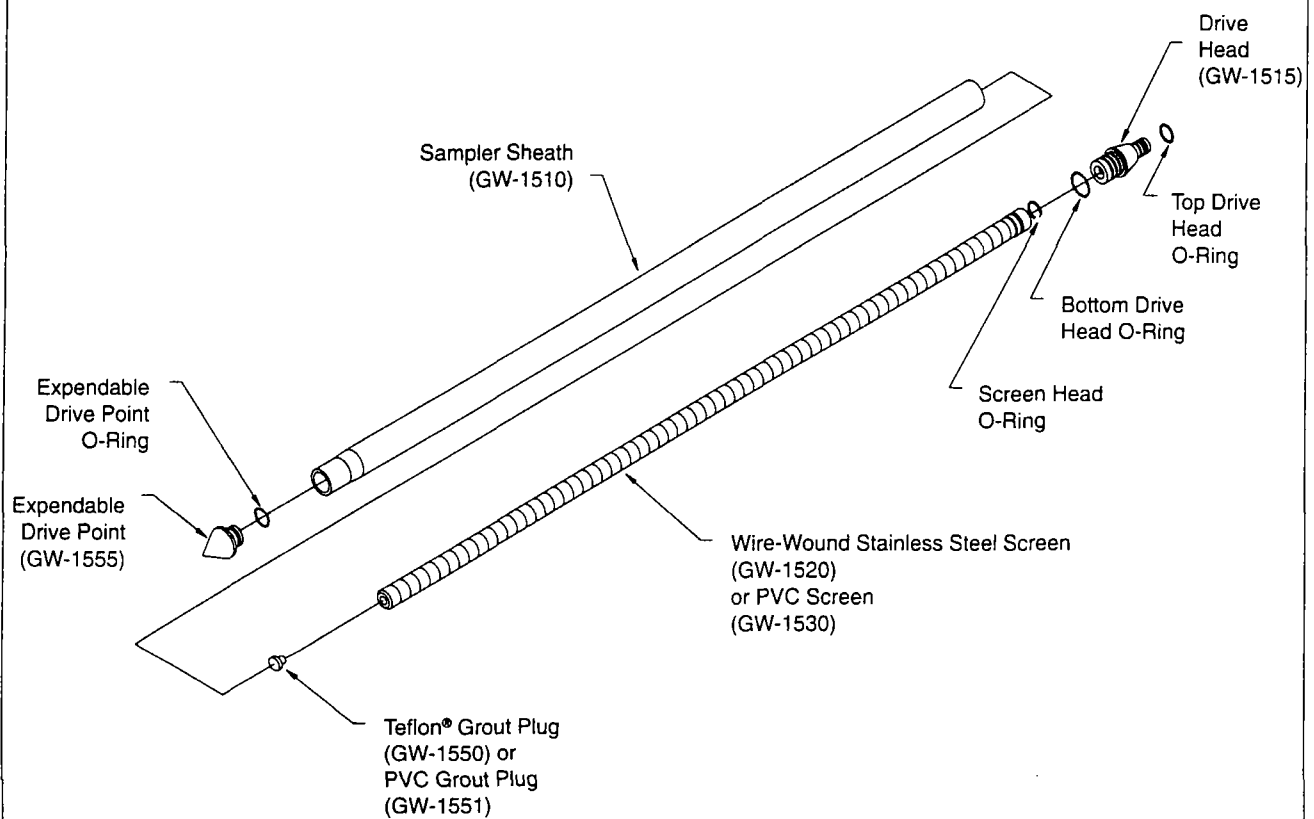


FIGURE 4.1
Screen Point 15 Groundwater Sampler Assembly

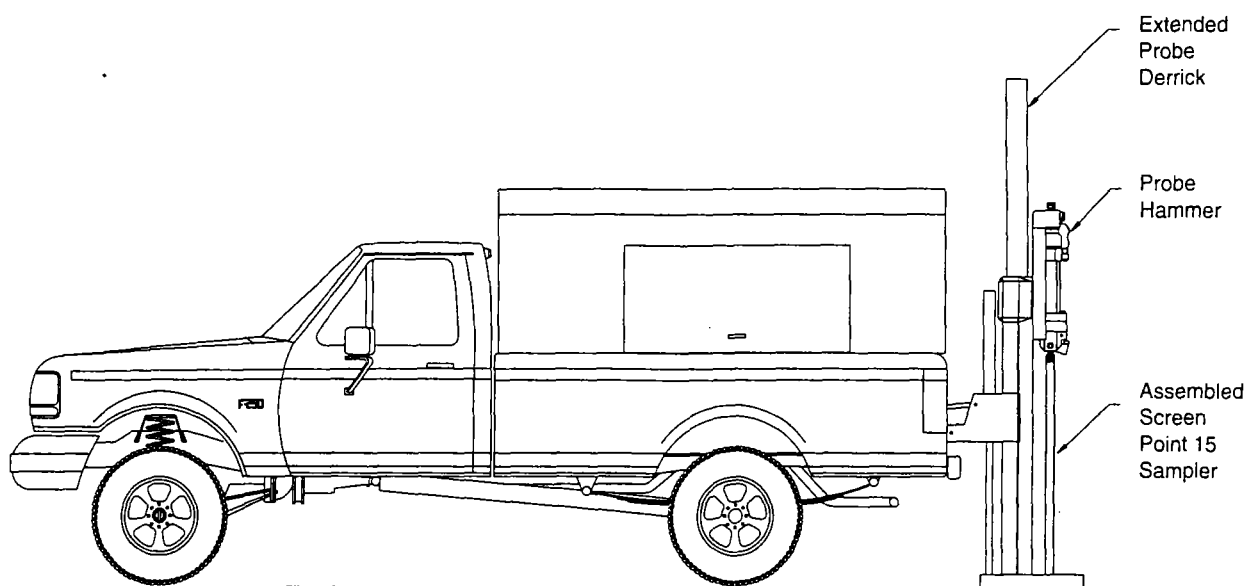


FIGURE 4.2
Screen Point 15 Groundwater Sampler in Driving Position

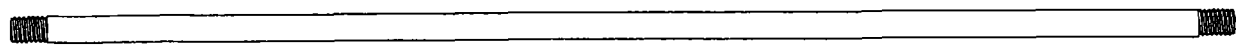
4.4 Driving the Screen Point 15 Sampler

To provide adequate room for screen deployment with the casing puller assembly, the probe derrick should be extended a little over halfway out of the carrier vehicle before driving the Screen Point 15 Sampler

1. Begin by placing the assembled sampler (Fig. 2.1) in the driving position beneath the hammer anvil on the extended probe derrick (Fig. 4.2).
2. Drive the sampler with throttle control at slow speed for the first 1 or 2 feet to ensure that the sampler is driving straight. Switch the throttle control to fast speed for the remainder of the probe stroke.
3. Completely raise the hammer assembly. Remove the drive cap and place an O-ring in the top groove of the drive head. Distilled water may be used to lubricate the O-ring if needed. Add a 36- or 48-inch (914 or 1219 mm) probe rod and reattach the drive cap to the rod string. Drive the sampler the entire length of the new rod with the throttle control at fast speed.
4. Repeat Step 3 until the desired sampling interval is reached. Approximately 12 inches (305 mm) of the last probe rod must extend above the ground surface to allow attachment of the puller assembly. A 12-inch (305 mm) rod may be added if the tool string is over-driven.
5. Remove the drive cap and retract the probe derrick away from the tool string.

4.5 Screen Deployment

1. Thread the screen push adapter (GW-1535, Fig. 4.3) on an extension rod (AT-67 or AT-671). Attach a coupler (AT-68) to the other end of the extension rod. Lower the extension rod inside of the probe rod taking care not to drop it down the tool string. An extension rod jig (Fig. 4.3) may be used to hold the rods.
2. Add extensions until the adapter contacts the bottom of the screen. To speed up this step, extension rod Quick Links (AT-694K, Fig. 4.3) are recommended.
3. Install the casing pull bracket (GW-3337) on the probe hammer (Fig. 4.4).
4. Reposition probe derrick and hammer assembly such that casing pull bracket is below top of probe rod.
5. Place the casing pull plate (GW-468) over the probe rod and install an open-bore pull cap (AT-12B) as shown in Figures 4.5A and B.
6. Ensure that at least 48 inches (1219 mm) of extension rod protrudes from the probe rod. Thread an extension rod handle (AT-69, Fig. 4.3) on the top extension.
7. Retract probe rods and sampler sheath while physically holding the screen in place with the extension rods (Fig. 4.5B). A slight knock with the extension rod string will help to dislodge the expendable point and start the screen moving inside the sheath. Raise the hammer and pull bracket assembly about 44 inches (1118 cm). At this point the screen head will contact the necked portion of the sampler sheath (Fig. 4.5C.) and the extension rods will rise with the probe rods. The screen is now deployed. Use care when deploying a PVC screen so as not to break the screen when it contacts the bottom of the sampler sheath.



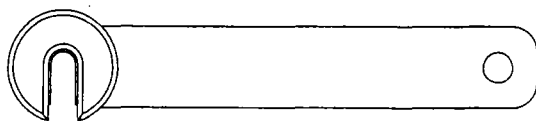
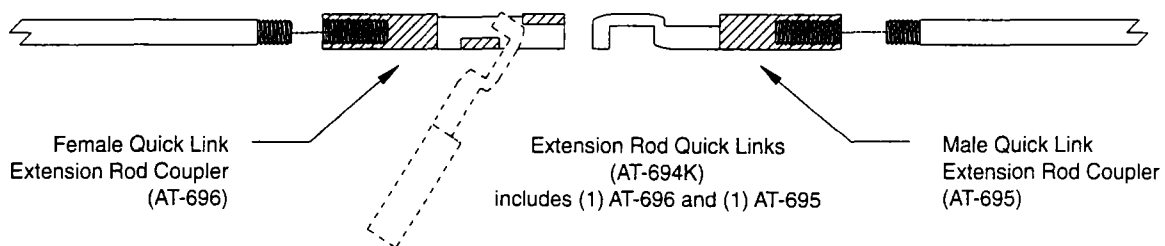
Extension Rod, 36 inch (AT-67) or 48 inch (AT-671)



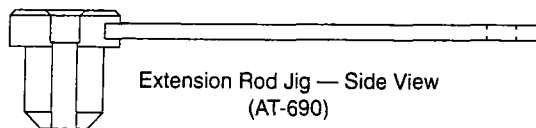
Grout Plug Push Adapter
(GW-1540)



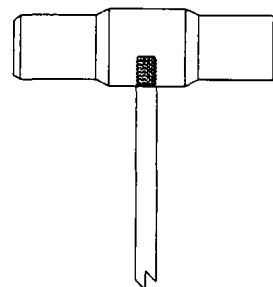
Screen Push Adapter
(GW-1535)



Extension Rod Jig — Top View
(AT-690)

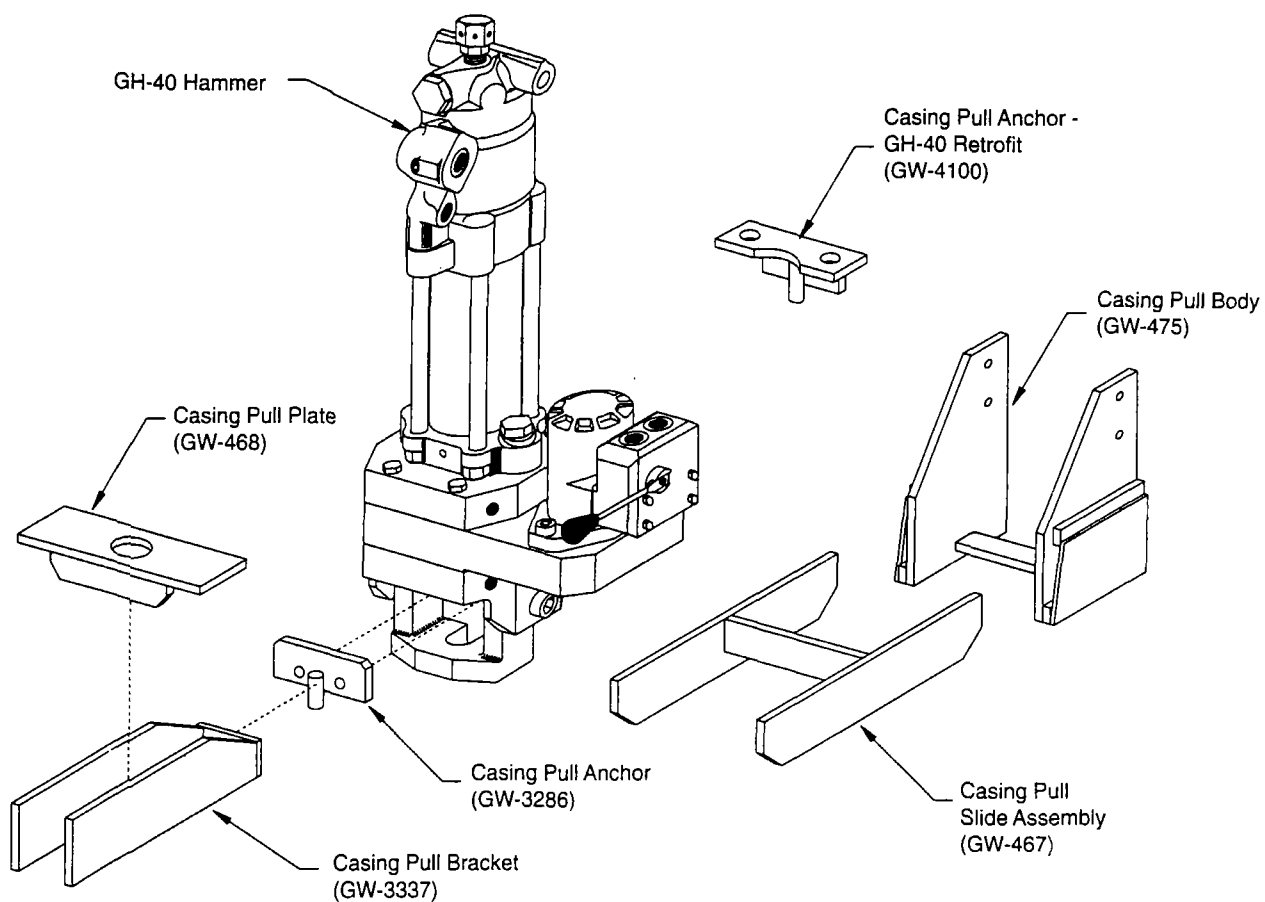


Extension Rod Jig — Side View
(AT-690)



Extension Rod Handle
(AT-69)

FIGURE 4.3
Geoprobe Extension Rods and Accessories



NOTES:

- 1) For GH-40 Hammer Retrofit Applications, Substitute GW-4100 for GW-3286.
- 2) For SK58 Hammer Applications, Substitute GW-467 for GW-3337, and GW-475 for GW-3286.

FIGURE 4.4
Casing Pull Assembly for Units Originally Equipped With The GH-40 Hammer

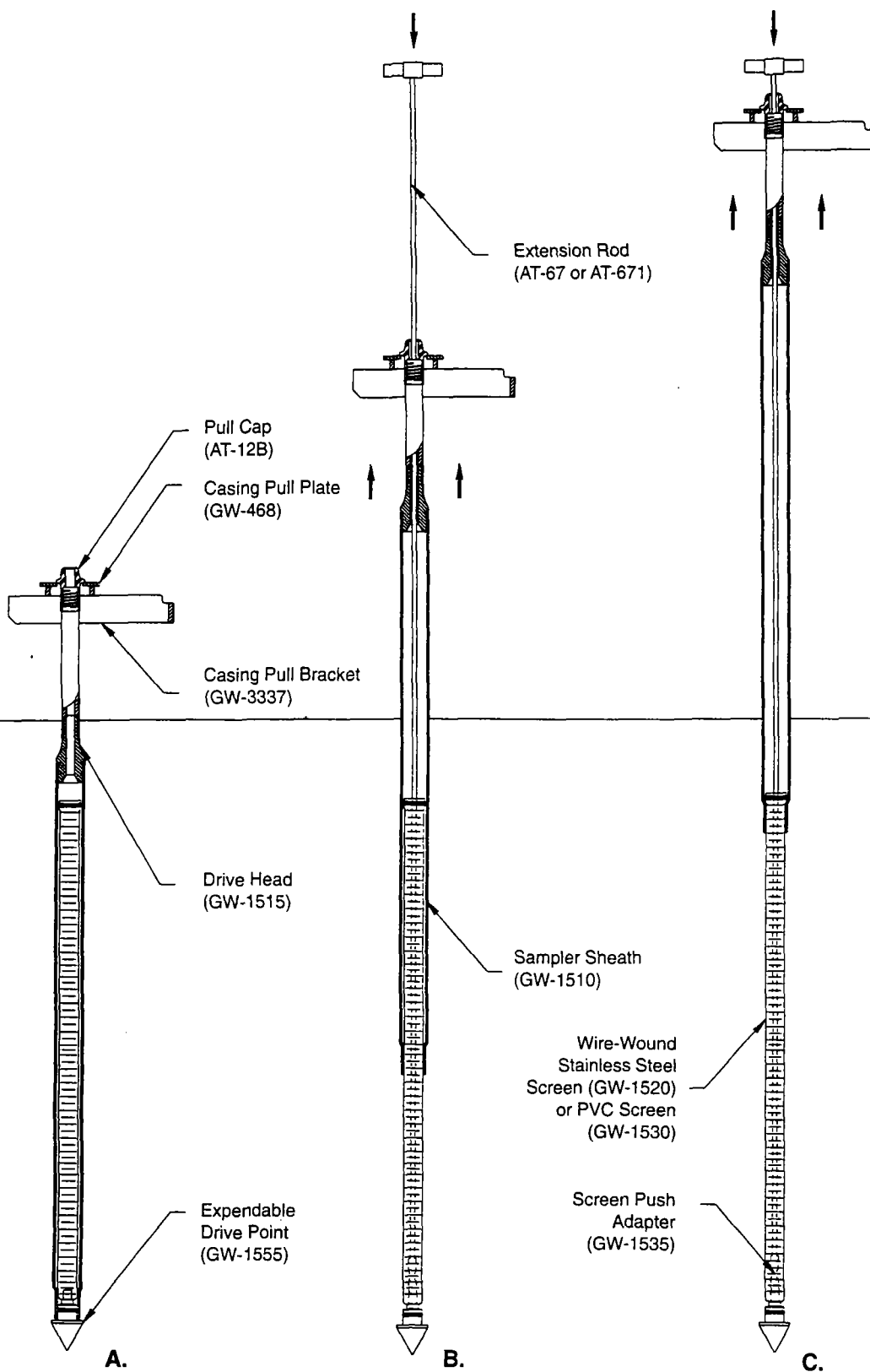


FIGURE 4.5
Screen Deployment

8. Lower the hammer assembly and retract the probe derrick. Remove the top extension rod and handle, pull cap, casing pull plate, and top probe rod. Finally, extract all extension rods.
9. Groundwater samples can now be collected with a mini-bailer, peristaltic or vacuum pump, tubing / bottom check valve assembly, or other acceptable small diameter sampling device.
10. When inserting the tubing down the rod string to collect a sample, ensure that the tubing enters the screen interval. The tubing will sometimes catch on the edge of the funnel opening of the screen head. An up-and-down and turning motion with the tubing helps to move it past the lip and into the screen.

4.6 Abandonment Grouting

The Screen Point 15 Sampler can meet ASTM D 5299-92 requirements for abandoning environmental wells or borings when grouting is conducted properly. A removable grout plug makes it possible to deploy tubing through the bottom of the screen. Grout is then pumped into the open probe hole as the sampler is withdrawn. The following procedure is presented as an example only and should be modified to satisfy local abandonment grouting regulations.

1. Position the casing pull bracket and pull plate over the tool string and place a split pull cap (AT-113) on the top probe rod. The sampler string can be pulled with the hammer latch while grouting. It is easier to manipulate the grout tube and probe rods, however, when the casing puller is utilized. A split pull cap is necessary for abandonment grouting as it makes it possible to pull probe rods without disconnecting the grout tube from the pump.

Raise the tool string approximately 4 to 6 inches (102 to 152 cm) to allow removal of the grout plug. Remove the pull cap.

2. Thread the grout plug push adapter (GW-1540, Fig. 4.3) onto an extension rod. Insert the adapter and extension rod inside the probe rod string. Add extensions until the adapter contacts the grout plug at the bottom of the screen. When the extension rods are slightly raised and lowered, a relatively soft rebound should be felt as the adapter contacts the grout plug. This is especially true when using a PVC screen.
3. Apply pressure to the extension rods and push the grout plug out of the screen. If working with a stainless steel screen, it may be necessary to raise and quickly lower the extension rods (much like a hammering action) to jar the plug free. When the plug is successfully removed from the stainless steel screen, a metal-on-metal sensation will be noted as the extension rods are quickly raised and lowered.

Note: Do not attempt to hammer on the grout plug if utilizing a PVC screen as the screen may break. A steady downward force should dislodge the plug.

When the grout plug is pushed from the screen, remove all extension rods.

4. A grout nozzle (GW-1545) is now connected to polyethylene tubing and inserted into the probe rods and down through the bottom of the screen (Fig. 4.6). Water flow should be maintained through the grout tubing and nozzle during deployment to prevent plugging the tube with sediment. Resistance will be felt as the grout nozzle passes through the drive head. Note this point as the nozzle tip should exit the end of the screen in approximately another 92 inches (2337 mm). Mark the tubing as desired.

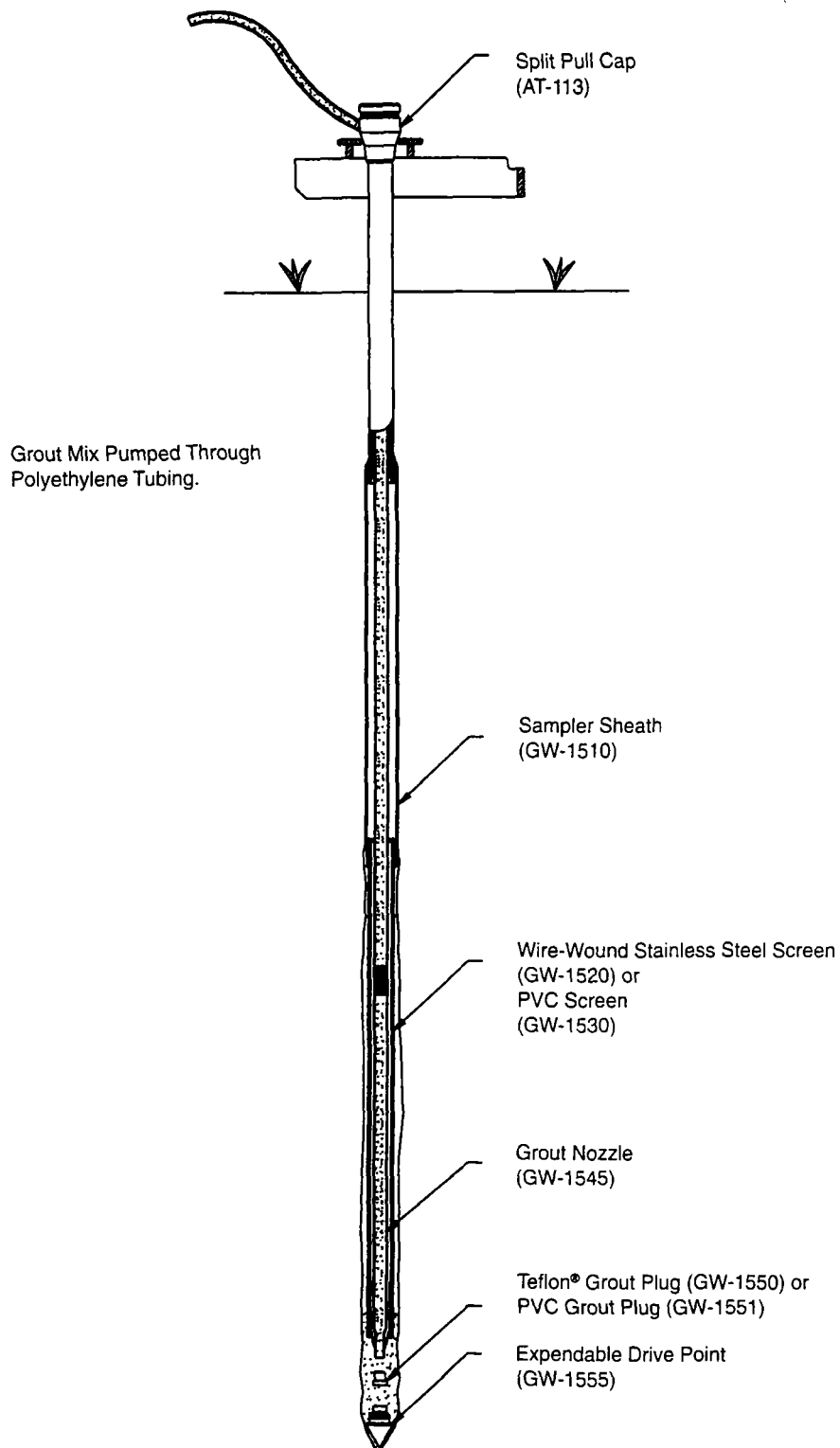


FIGURE 4.6
Grouting Through The Screen Point 15 Groundwater Sampler

Once fully deployed, the two spring-like tongues at the end of the grout nozzle (Fig. 4.6) will expand and prevent it from coming up out of the hole while pumping grout. Gently pull up on the polyethylene tubing to ensure that the nozzle has locked into place.

Note: All probe rods remain strung on the tubing as the tool string is pulled. Provide extra tubing length to allow sufficient room to lay the rods on the ground as they are removed. An additional 30 percent length is generally enough.

5. Attach a split pull cap to the top probe rod. Position the polyethylene tubing in the pull cap slot taking care not to pinch or bind the tubing. Operate the grout pump while pulling the first rod. Remove the split pull cap and unscrew the probe rod. Slide the rod over the tubing and place it on the ground near the end of the tubing to leave room for the remaining probe rods.
6. Repeat Step 5 until the sampler is retrieved. Do not bend or kink the tubing when pulling and laying out the probe rods. Sharp bends create weak spots in the tubing which may burst when pumping grout. Remember to operate the grout pump only when pulling the rod string. The probe hole is thus filled with grout from the bottom up as the rods are extracted.
7. Promptly clean all probe rods and sampler parts before the grout sets up and clogs the equipment.

4.7 Retrieving the Screen Point 15 Sampler

If grouting is not required, the Screen Point 15 sampler can be retrieved by pulling the probe rods as with most other Geoprobe sampling applications.

1. Position the probe derrick and hammer assembly over the tool string. Thread a pull cap onto the top probe rod. Once again, a split pull cap may be used to save time.
2. Lower the hammer latch over the pull cap and retract the tool string one probe rod length.
3. Remove the pull cap and top probe rod and repeat Step 2 until the sampler sheath is at the ground surface.
4. Physically pull the sampler sheath and screen out of the ground taking care not to bend the screen on the way out. The Screen Point 15 Groundwater Sampler is now retrieved and ready to decontaminate for further use.

5.0 REFERENCES

American Society for Testing and Materials (ASTM) 1993. Standard Guide for Decommissioning of Groundwater Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities: D 5299-92.

Geoprobe Systems, 1995, "1995-96 Tools and Equipment Catalog".

SECTION 17.01

ATTACHMENT B

**GEOPROBE PREPACKED SCREEN
MONITORING WELL**

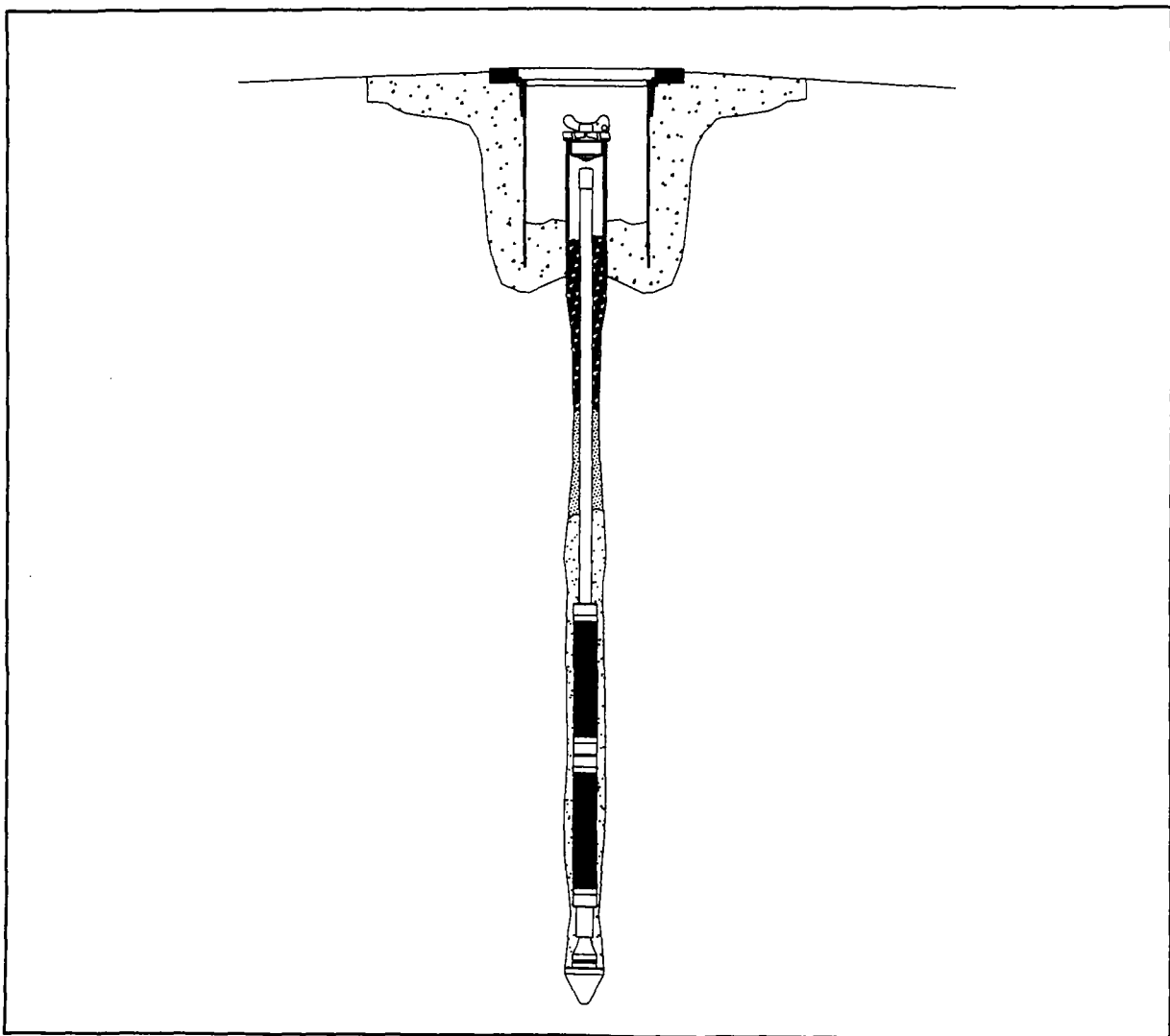
THIS ATTACHMENT IS NOT AVAILABLE ELECTRONICALLY

GEOPROBE PREPACKED SCREEN MONITORING WELL

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 96-2000

September, 1996



GEOPROBE PREPACKED SCREEN MONITORINGWELL

1.0 OBJECTIVE

The objective of this procedure is to install a permanent, small diameter groundwater monitoring well that can be used to collect water quality samples, conduct hydrologic and pressure measurements, or perform any other sampling event that does not require large amounts of water at any given time.

2.0 BACKGROUND

2.1 Definitions

Geoprobe® Soil Probing Machine: A vehicle-mounted, hydraulically-powered machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

**Geoprobe® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas.*

Prepacked Screen: The Geoprobe prepacked screens are available in 3-foot sections which have an outside diameter of 1.5 inches (38 mm) and an inside diameter of 0.5 inches (12.7 mm). The inner component of the prepacked screens consists of 0.5-inch Schedule 80 PVC with 0.01-inch (0.25 mm) slots. The outer component of the screen is stainless steel wire mesh with a pore size of 0.011 inches (0.28 mm). The screens are prepacked with 20/40 grade silica sand.

2.2 Discussion

This procedure describes how 2.125-inch (54 mm) outside diameter (O.D.) probe rods are advanced to a predetermined depth using a Geoprobe percussion probing machine to allow for the installation of a permanent monitoring well. The permanent monitoring well is assembled and installed through the 1.5-inch (38 mm) inside diameter (I.D.) of the probe rods. The well is constructed with prepacked screens and 0.5-inch Schedule 80 PVC well riser.

Once the rods are set at depth, the prepacked screens are lowered through the 1.5-inch (38 mm) I.D. of the probe rods as additional PVC riser is added to the well assembly (Fig. 2.1-A). The prepacked screens are attached to an expendable anchor point by a locking connector threaded to the bottom of the prepacked screens. When the prepacked screens are locked into the anchor point the probe rods are retracted. As the rods are retracted above the screens, either natural formation collapse or a fine-grade sand installed by gravity through the rod annulus, is used to form a barrier above the prepacked screens (Fig. 2.1-B). This sand or natural formation barrier prevents bentonite grout from penetrating into the screened interval. Granular bentonite or bentonite slurry is then installed in the annulus to form a well seal (Fig. 2.1-B). A high-pressure grout pump (Geoprobe Model GS-1000) may be used to pump high-solids bentonite slurry or neat cement grout to fill the well annulus as the probe rods are retracted (Fig. 2.1-B). The grout mixture must be pumped from the bottom up to accomplish a tight seal and to meet regulatory requirements.

In certain formation conditions, the prepacked screens may bind inside the probe rods as the rods are retracted. This is most common in sandy formations sometimes called flowing or heaving sands. This binding can generally be overcome by lowering extension rods down the inside of the well riser and gently, but firmly, tapping the extension rods against the base of the well as the rods are slowly retracted. If the binding persists, clean tap water or distilled water may be poured down the annulus of the rods to increase

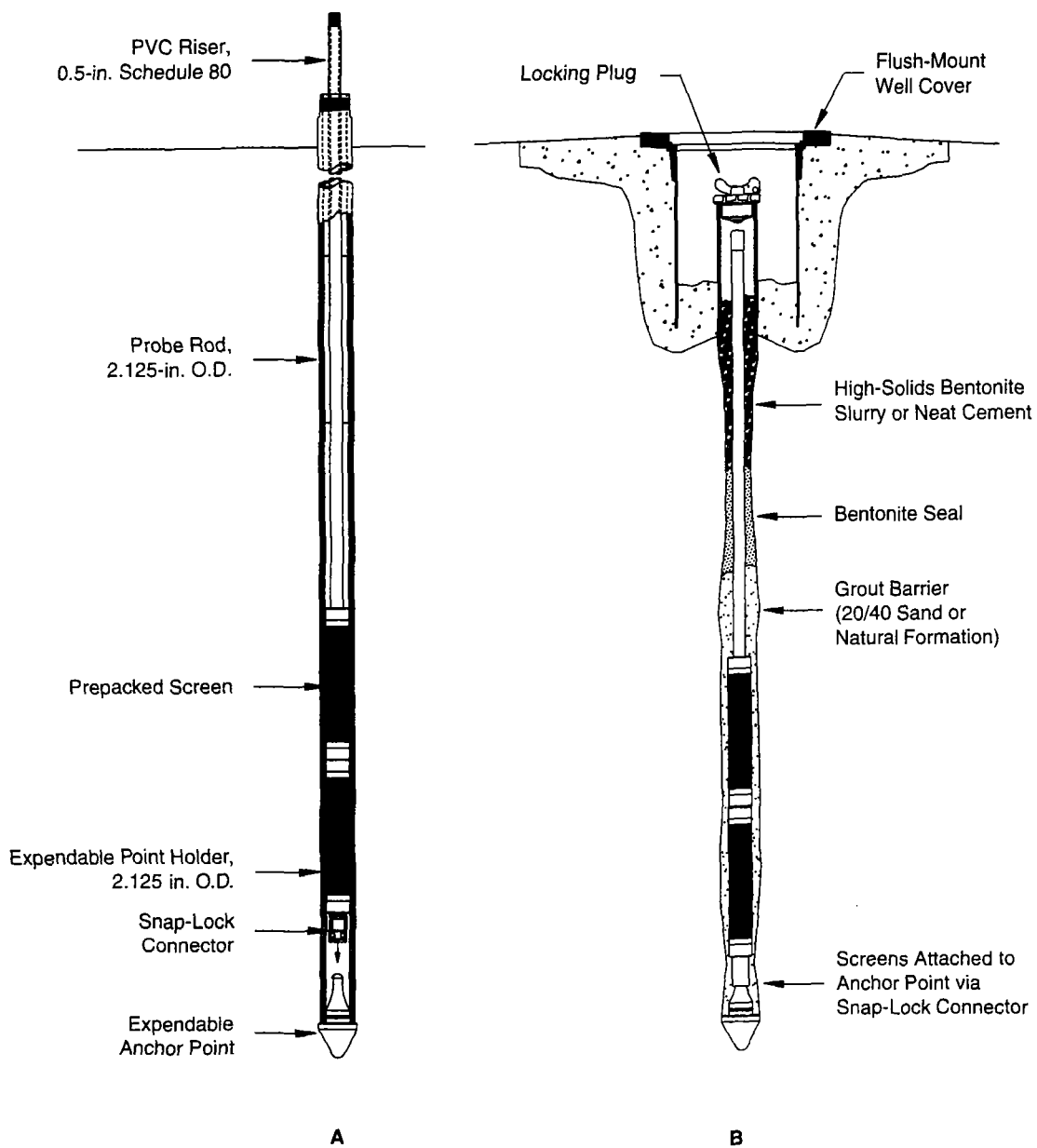


FIGURE 2.1
Insertion of Prepacked Screens (A) and Installed Geoprobe Monitoring Well (B)

the hydraulic head inside the well. This, combined with the use of the extension rods, will free up the prepacked screen and allow for proper emplacement.

Once the well is set, conventional flush-mount or aboveground well protection can be installed to prevent tampering or damage to the well head (Fig. 2.1-B). These wells can be sampled by several available methods (peristaltic pump, mini-bailer, Geoprobe's tubing check valve, etc.) to obtain high integrity water quality samples. These wells also provide accurate water level measurements and can be used as observation wells during aquifer pump tests.

When installed properly, these small diameter wells generally meet regulatory requirements for a permanent monitoring well. While a detailed installation procedure is given in this document, it is by no means totally inclusive. Always check local regulatory requirements and modify the procedure accordingly.

3.0 REQUIRED EQUIPMENT

The following equipment is required to install a permanent monitoring well with the Geoprobe prepacked screens and probing system. Figure 3.1 identifies the major monitoring well components.

MONITORINGWELL PARTS	QUANTITY	PART NUMBER
Prepacked Screen	Variable	GW-2010
Snap-Lock Connector Assembly	-1-	GW-2030
Expendable Anchor Point, 2.125-inch	-1-	GW-2040
PVC Riser, 0.5-inch Schedule 80 (5-foot lengths)	Variable	GW-2050
PVC Top Cap, 0.5-inch Flush-Threaded	-1-	GW-2055
GEOPROBETOOLS	QUANTITY	PART NUMBER
O-rings for 2.125-inch Probe Rod, (Pkg. of 25)	Variable	AT-2100R
Drive Cap, 2.125-inch	-1-	AT-2101
Expendable Point Holder, 2.125 x 36 inches (optional)	-1-	AT-2110
Expendable Point Holder, 2.125 x 48 inches	-1-	AT-2111
Probe Rod, 2.125 x 36 inches (optional)	Variable	AT-2136
Probe Rod, 2.125 x 48 inches	Variable	AT-2148
Rod Grip Puller Assembly	-1-	AT-2150K
Vinyl Cap, 0.812 inch I.D.	-1-	AT-441
Extension Rod, 36-inch (optional)	Variable	AT-67
Extension Rod, 48-inch	Variable	AT-671
Extension Rod Coupler	Variable	AT-68
Extension Rod Handle	-1-	AT-69
Extension Rod Quick Links (optional)	Variable	AT-694K
Grout Machine	-1-	GS-1010
Water Level Sounder	-1-	GW-1200
Screen Push Adapter	-1-	GW-1535
Stainless Steel Mini-Bailer Assembly (optional)	-1-	GW-41
Tubing Bottom Check Valve	-1-	GW-42
O-rings for 0.5-inch PVC Riser (Pkg. of 25)	Variable	GW-430R
Polyethylene Tubing, 3/8 inch O.D.	Variable	TB-25L
ADDITIONAL TOOLS AND EQUIPMENT	QUANTITY	PART NUMBER
Locking Pliers	-2-	FA-200
Pipe Wrench	-2-	
Volumetric Measuring Cup	-1-	
PVC Cutting Pliers	-1-	
Weighted Measuring Tape (optional)	-1-	
Small Funnel or Flexible Container (for pouring sand)	-1-	
Duct Tape Roll	-1-	
Bucket or Tub (for dry material, water, and mixing)	-3-	
PVC Pipe, 2-inch Schedule 40 (24-inch section)	-1-	
J Plug (locking plug), 2-inch	-1-	
Well Cover (aboveground or flush-mount)	-1-	
Sand, 20/40 grade	Variable	
Bentonite, granular (8 mesh)	Variable	AT-91
Bentonite, powdered (200 mesh)	Variable	AT-92
Portland Cement, Type I	Variable	
Concrete Mix (premixed cement and aggregate)	Variable	
Clean Water	Variable	

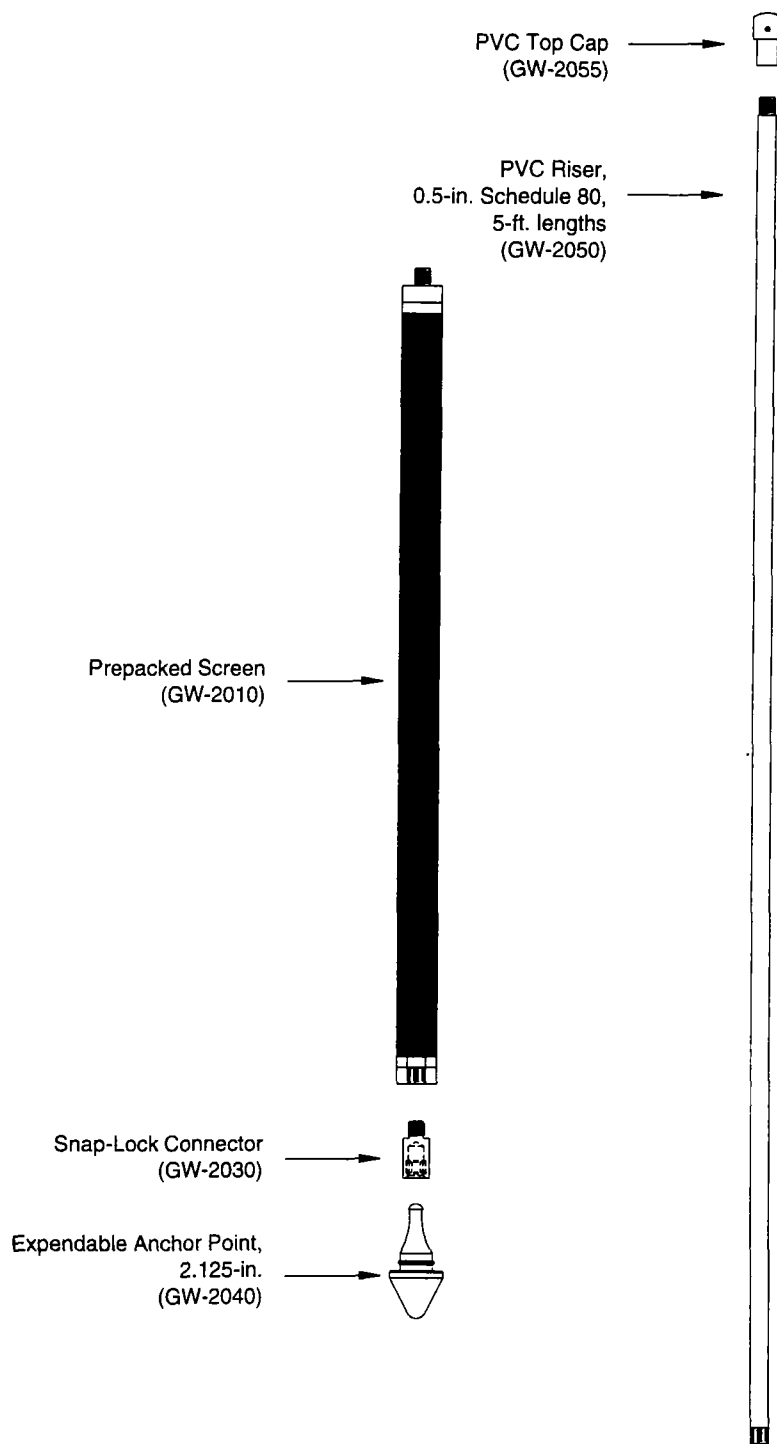


FIGURE 3.1
Prepacked Screen Monitoring Well Parts

4.0 WELL INSTALLATION

Monitoring well installation can be broken down into five main steps:

- Anchoring the well assembly at depth
- Providing a sand pack and grout barrier
- Installing a bentonite seal above the screen
- Grouting the well annulus
- Installing a surface cover

4.1 Anchoring Well Assembly

In this portion of the well installation procedure, an expendable anchor point is driven to depth on the end of a 2.125-inch (54 mm) O.D. probe rod string (Fig. 4.1). A prepacked screen assembly is inserted into the I.D. of the rod string with 5-foot (1.5 m) sections of 0.5-inch PVC riser pipe (Fig. 4.2). The screens and riser pipe are attached to the anchor point via a snap-lock connector.

1. If the monitoring well is to have a flush-mount finish, it is a good practice to prepare a hole large enough to accept a standard well protector before driving the probe rods.
2. Move the Geoprobe probing machine into position over the proposed monitoring well. Unfold the probe and place in the proper probing position as shown in the unit Owner's Manual. Access to the top of the probe rods will be required. It is therefore important to allow room for some derrick retraction when placing the unit in the probing position.
3. Referring to Figure 4.3, place an O-ring in the groove of a 2.125-inch Expendable Anchor Point (GW-2040). Insert the point into the unthreaded end of a 2.125-inch Expendable Point Holder (AT-2110 or AT-2111).

NOTE: Unlike other Geoprobe applications, the 2.125-inch expendable point holders are actually modified probe rods. These expendable point holders are available in lengths of 36 inches (AT-2110) and 48 inches (AT-2111).

4. Attach a 2.125-inch Drive Cap (AT-2101) to the threaded end of the point holder (Fig. 4.3).
5. Place the expendable point holder under the probe hammer in the driving position (refer to unit Owner's Manual). Drive the point holder into the ground utilizing percussion if necessary. To provide a representative monitoring well, it is important that the rod string is driven as straight as possible. If the point holder is not straight, pull the assembly and start over with Step 2.
6. Remove the drive cap from the expendable point holder. Install an O-ring (AT-2100R) on the point holder in the groove located at the base of the male threads (Fig. 4.4).
7. Thread a probe rod (AT-2136 or AT-2148) onto the expendable point holder. Place the drive cap on the probe rod and advance the rod string.
8. Remove the drive cap and install an O-ring (AT-2100R) at the base of the male threads of the probe rod (Fig. 4.4). Add another probe rod and replace the drive cap. Once again, advance the rod string.

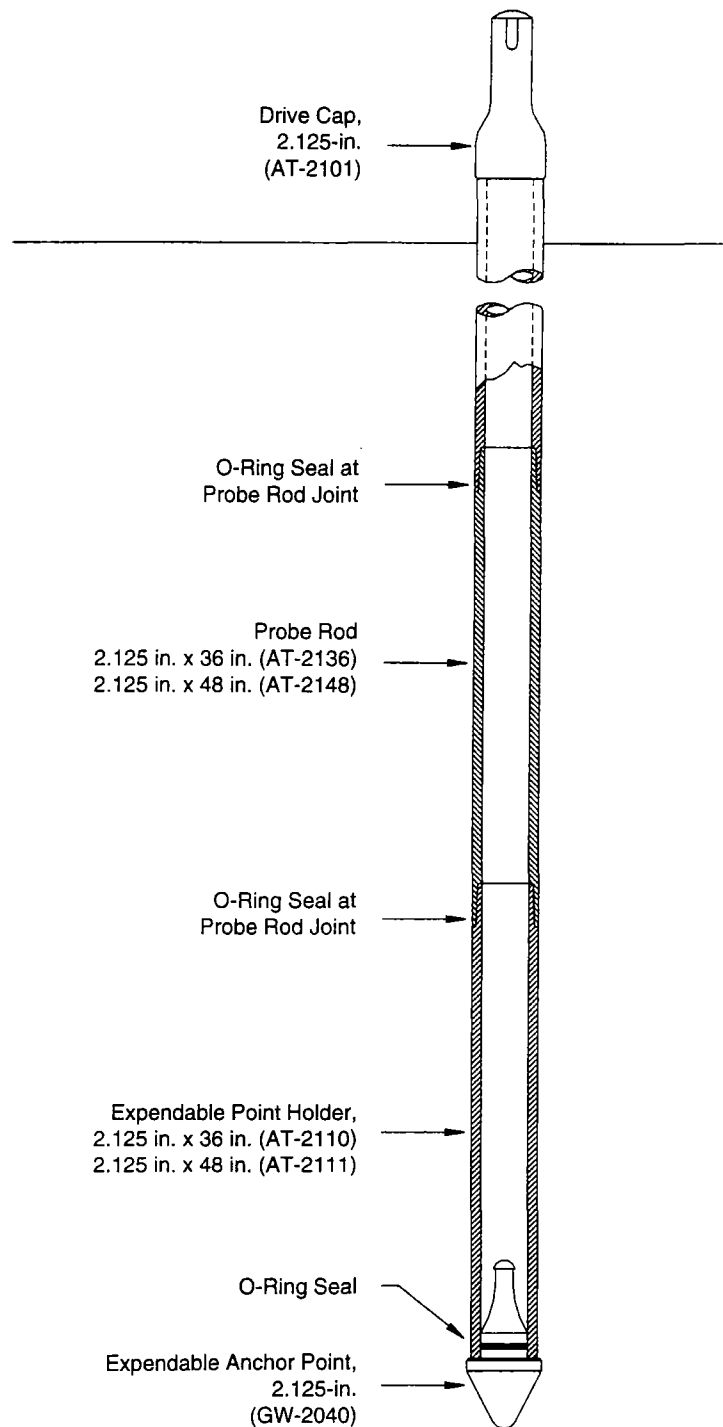


FIGURE 4.1
Expendable Anchor Point Driven To Depth

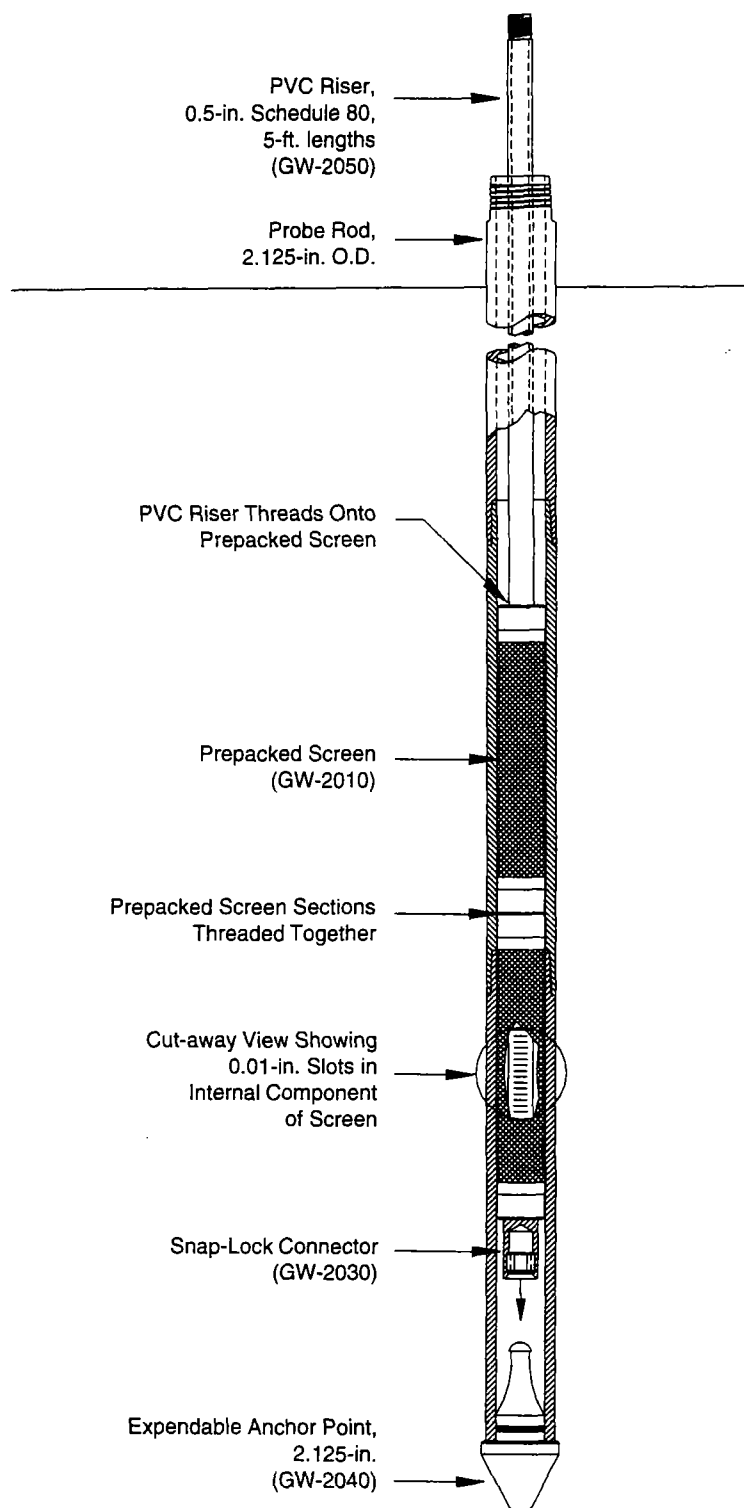


FIGURE 4.2
Prepacked Screens Inserted into Inside Diameter of Probe Rod String

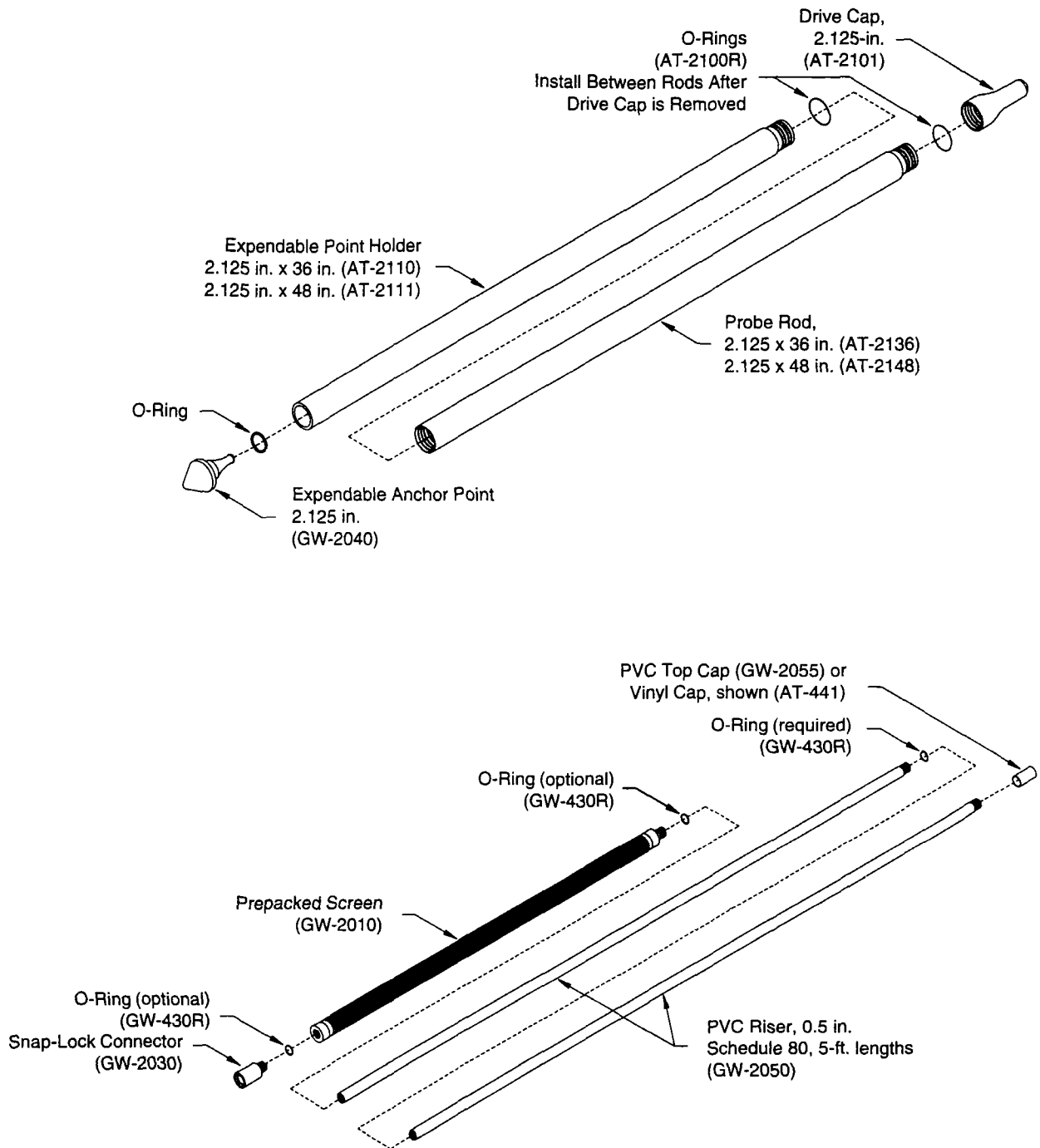


FIGURE 4.3
Prepacked Screen and Probe Rod Assembly

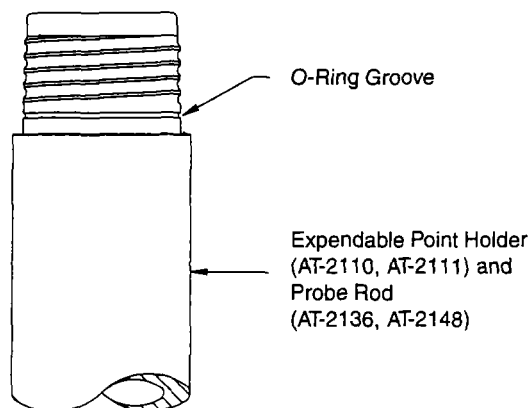


FIGURE 4.4
O-Ring Groove in 2.125-inch Expendable Point Holders and Probe Rods

9. Repeat Step 8 until the end of the rod string is 4 inches (102 mm) below the bottom of the desired screen interval. The additional depth allows for the connection between the expendable anchor point and screen assembly. The top probe rod must also extend at least 1 foot (25 mm) above the ground surface to allow room for the rod grip puller later in this procedure. Move the probe foot back to provide access to the top of the rod string.
10. With the probe rods and anchor point driven to the proper depth, the next step is to deploy the screen and riser pipe. Begin by threading together three-foot Prepacked Screen sections (GW-2010) to achieve the desired screen interval (Fig. 4.3). O-rings (GW-430R) can be installed between the screen sections if desired.
11. Thread a Snap-Lock Connector (GW-2030) into the female end of the assembled screens (Fig. 4.3). An O-ring (GW-430R) can be placed on the male threads of the connector if desired.
12. Insert the screen assembly into the top of the probe rod string with the connector facing toward the bottom of the rods, Figure 4.2.
13. With the assistance of a second person, attach 5-foot (1.5 m) sections of 0.5-inch Schedule 80 PVC Riser (GW-2050) to the top of the screen assembly. O-rings (GW-430R) are required at each riser joint to prevent groundwater from seeping into the screens from above the desired monitoring interval. Continue to add riser sections until the assembly reaches the bottom of the rods (Fig. 4.2). At least one foot (0.3 m) of riser should extend past the top probe rod. Place a PVC Top Cap (GW-2055) or Vinyl Cap (AT-441) on the top riser. If using the vinyl cap, secure the cap with two wraps of duct tape.
14. Raise the screen and riser assembly a few inches and then quickly lower it onto the expendable anchor point. This should force the snap-lock connector over the mushroomed tip of the anchor (Fig. 4.5). Gently pull up on the riser to ensure that the connector and anchor are firmly attached. Approximately 0.25 inches (6 mm) of play is normal.

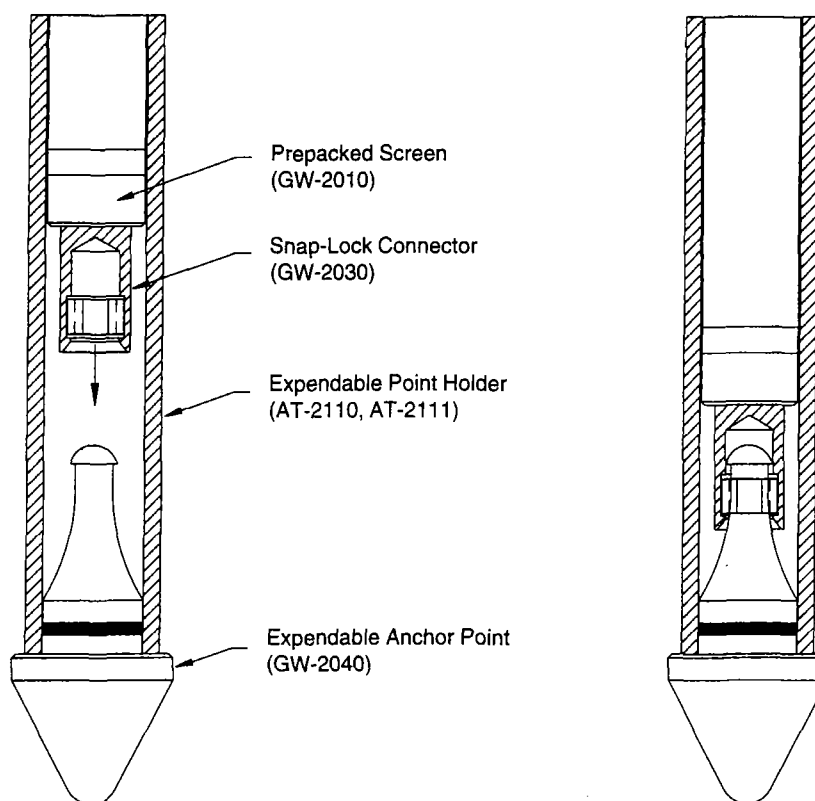


FIGURE 4.5
Connecting Screen Assembly To Expendable Anchor Point

15. It is now time to pull up the probe rods from around the well screen and riser. Reposition the probe unit so that the Rod Grip Puller (AT-2150K) can be attached to the rod string.
16. Retract the rod string the length of the screens plus an additional 3 feet (1 m). While pulling the rods, observe whether the PVC risers stay in place or move up with the rods.
 - a. If the risers stay in place, stable formation conditions are present. Continue retracting the rods to the depth specified above. Go to Section 4.2.
 - b. If the risers move up with the probe rods, have a second person hold it in place while pulling up the rods. An additional section of PVC riser may be helpful. Once the probe rods have cleared the anchor point and part of the screen, the screen and riser assembly should stop raising with the rods. Continue retracting to the depth specified above. Go to Section 4.2.
 - c. If the risers continue to move up with the probe rods and can not be held in place by hand, the anchor point is most likely located in heaving sands. Extension rods are now required. (Refer to Figure 4.6 for an illustration of extension rod accessories.)

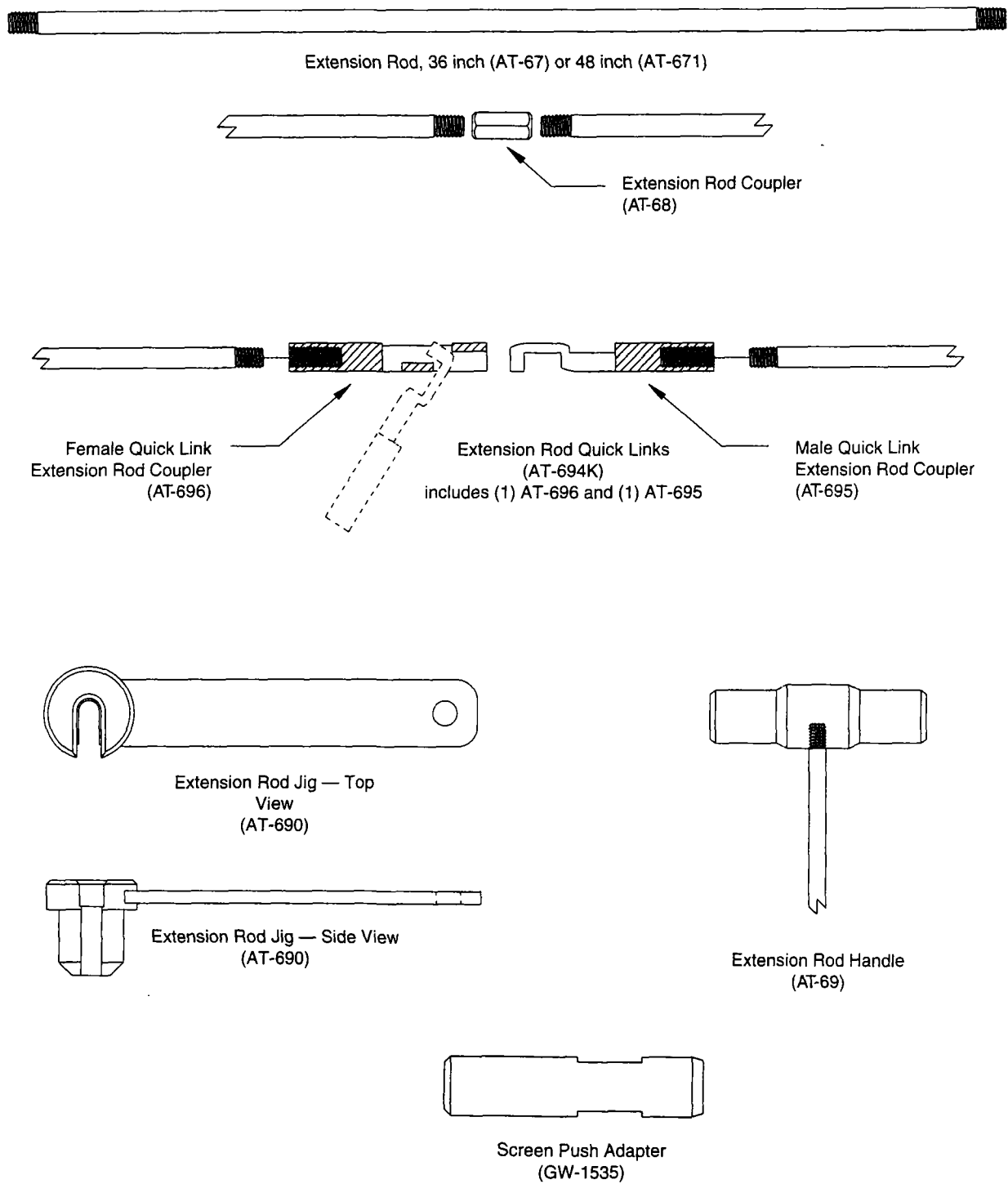


FIGURE 4.6
Geoprobe Extension Rods and Accessories

- d. Place a Screen Push Adapter (GW-1535) on the end of an Extension Rod (AT-67 or AT-671). Insert the adapter and extension rod into the PVC riser and hold by hand or with an Extension Rod Jig (AT-690). Attach additional extension rods with Extension Rod Couplers (AT-68) or Extension Rod Quick Links (AT-694K) until the push adapter contacts the bottom of the screens (Fig. 4.7). Place an Extension Rod Handle (AT-69) on the top extension rod after leaving 3 to 4 feet (1 to 1.2 m) of extra height above the last probe rod.
- e. Slowly retract the probe rods while another person pushes and taps on the screen bottom with the extension rods (Fig. 4.7). To ensure proper placement of the screen interval and prevent damage to the well, be careful not to get ahead while pulling the probe rods. The risers should stay in place once the probe rods are withdrawn past the screens. Retrieve the extension rods. Place the cap back on the top riser and secure the cap with duct tape if necessary.

4.2 Sand Pack and Grout Barrier

The natural formation will sometimes collapse around the well screens as the probe rod string is withdrawn. This provides an effective barrier between the screens and grout material used to seal the well annulus. If the formation does not collapse, a sand pack must be placed from the surface. This portion of the well installation procedure is important because an inadequate barrier will allow grout to reach the well screens. Nonrepresentative samples and retarded groundwater flow into the well result from grout contamination.

1. Using a Water Level Sounder (GW-1200) or flat tape measure, determine the depth from the top of the PVC riser to the bottom of the annulus between the riser and probe rods. Two scenarios are possible:
 - a. Measured depth is 2 to 3 feet (0.6 to 0.9 m) less than riser length. This indicates that unstable conditions have resulted in formation collapse. A natural grout barrier was formed as material collapsed around the PVC riser when the probe rods were retracted. This commonly occurs in heaving sands. No further action is required. Proceed with Section 4.3 and perform Step 2 (for stable formations).
 - b. Measured depth is equal to or greater than riser length. This indicates that stable conditions are present. The probe hole has remained open and void space exists between the riser (and possibly the screen) and formation material. Clean sand must be placed downhole to provide a suitable grout barrier. Continue with Step 2.
2. Begin slowly pouring 20/40 grade sand down the annulus between the PVC riser and probe rod string. Reduce spillage by using a funnel or flexible container as shown in Figure 4.8. Add approximately 1.25 liters for each 3-foot (1 m) screen section, plus 1.25 liters for a 2-foot (0.6 m) layer of sand above the screen section.
3. Measure the annulus depth after each 1.25 liters of sand. The sand may not fall all the way past the screens due to the tight annulus and possible water intrusion. This is acceptable, however, since the prepacked screens do not require the addition of sand. The important thing is that a sand barrier is provided above the screens.
4. Sand may also bridge within the annulus between the risers and probe rods and consequently fail to reach total depth (Fig. 4.8). This most likely occurs when the sand contacts the water table during deep well installations. Wet probe rods also contribute to sand bridging. If the annulus is open, skip to Section 4.3, Step 1. If bridging is evident, continue with Step 5.

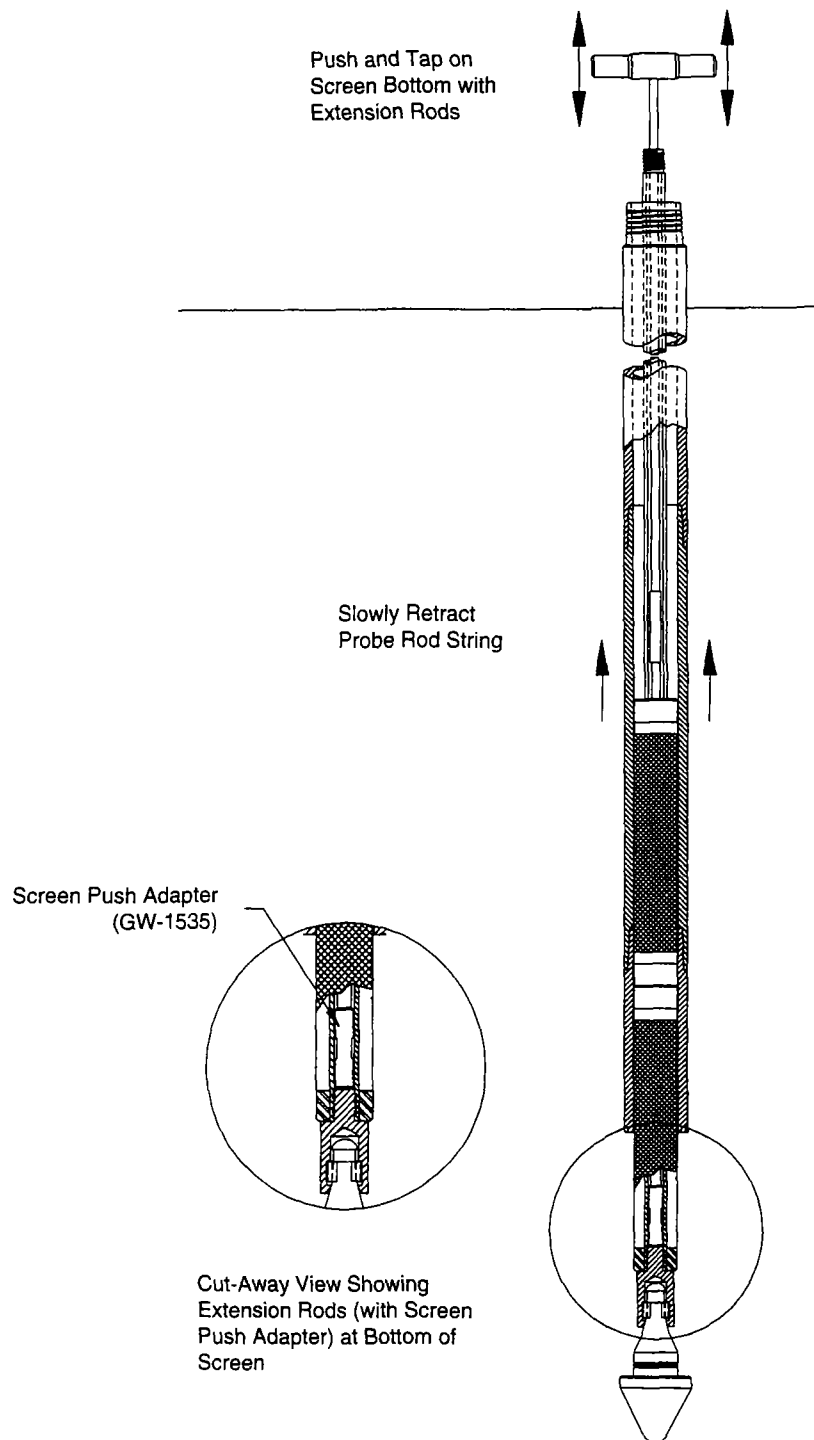


FIGURE 4.7
Use Extension Rods To Tap Out Wedged Screens

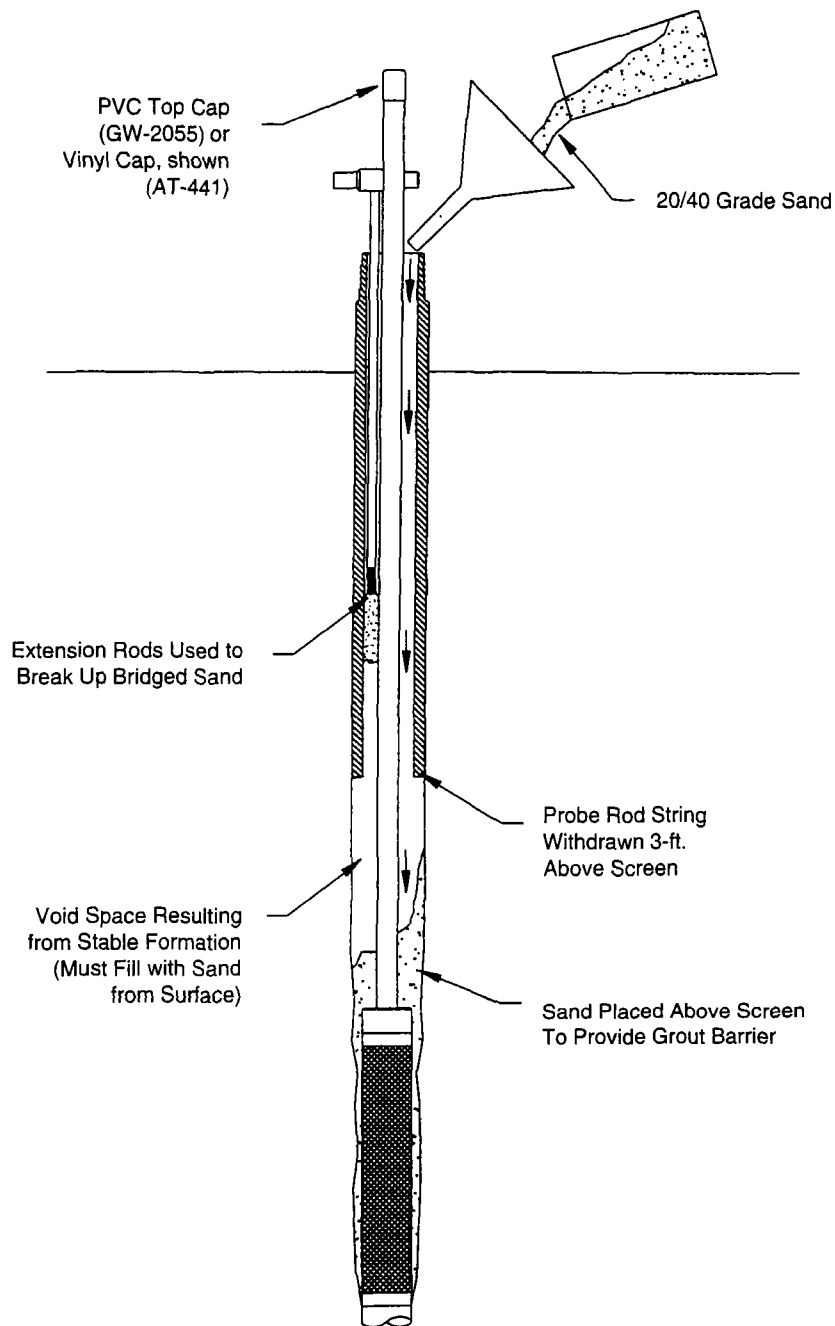


FIGURE 4.8
Installing Grout Barrier from Ground Surface with 20/40 Grade Sand

5. In case of a sand bridge above the screens (wet rods, high water table, etc.), insert clean extension rods into the well annulus to break up the sand (Fig. 4.8). Simultaneously retracting the probe rods usually helps. Check annulus depth again. If sand is no longer bridged, proceed to Section 4.3. If bridging is still evident, continue with Step 6.
6. If the sand bridge can not be broken up with extension rods, inject a small amount of clean water into the annulus. This is accomplished with a Geoprobe Model GS-1000 Grout Machine (GS-1010 includes grout machine and accessories) and 3/8-inch (9.5 mm) O.D. polyethylene tubing (TB-25L). Simply insert the poly tubing down the well annulus until the sand bridge is contacted. Attach the tubing to the grout machine and pump up to one gallon of clean water while moving the tubing up and down. The jetting action of the water will loosen and remove the sand bridge. Check annulus depth again. The distance should be 2 to 3 feet (0.6 to 0.9 m) less than the riser length. Proceed with Section 4.3.

4.3 Bentonite Seal Above Screen

Bentonite is an expanding clay which exhibits very low permeability. When properly placed, bentonite prevents contaminants from moving into the well screens from above the desired monitoring interval. The seal is formed either by pouring granular bentonite into the annulus from the ground surface, or by injecting a high-solids bentonite slurry directly above the grout barrier. The use of bentonite chips is limited to cases in which the top of the screen ends above the water table (no water is present in the probe rods). Whichever method is used, at least 2 feet (0.6 m) of bentonite must be placed above the sand pack.

1. (Stable Formation) Granular bentonite is recommended if the following conditions are met:

- 1) Top of screen interval is above the water table
 - 2) Formation remained open when probe rods were retracted
 - 3) Bridging was not encountered while installing the sand pack and grout barrier in Section 4.2.
- a. Withdraw the probe rod string another 3 to 4 feet (0.9 to 1 m) and ensure that the PVC riser does not rise with rods. It is important that the bottom of the rod string is above the proposed seal interval. If positioned too low, dry bentonite will backup into the expendable point holder. Bridging then results if moisture is present inside the probe rods.
 - b. Pour approximately 1.5 liters of granular bentonite between the probe rods and PVC riser as was done with the sand in Section 4.2
 - c. Measure the riser depth to the bottom of the annulus. The distance should now equal the installed riser length minus the minimum 2 feet (0.6 m) of sand pack and 2 feet (0.6 m) of bentonite seal. As was stated with the sand pack, if the measured depth is significantly less than expected, the bentonite has more than likely bridged somewhere along the rod string. A procedure similar to that identified for bridged sand (Section 4.2, Steps 5 and 6) may be utilized to dislodge the granular bentonite.
 - d. Once it has been determined that the bentonite seal is properly emplaced, add 1 liter of clean water to hydrate the dry bentonite according to regulations. This is not necessary if water was used to clear bridged bentonite.

2. (Unstable Formation) A grout machine is required to install the bentonite seal if the formation collapsed when the rods were retracted or the sand bridged when installing the grout barrier. The pump is able to supply a high-solids bentonite slurry under sufficient pressure to displace collapsing soil. Void

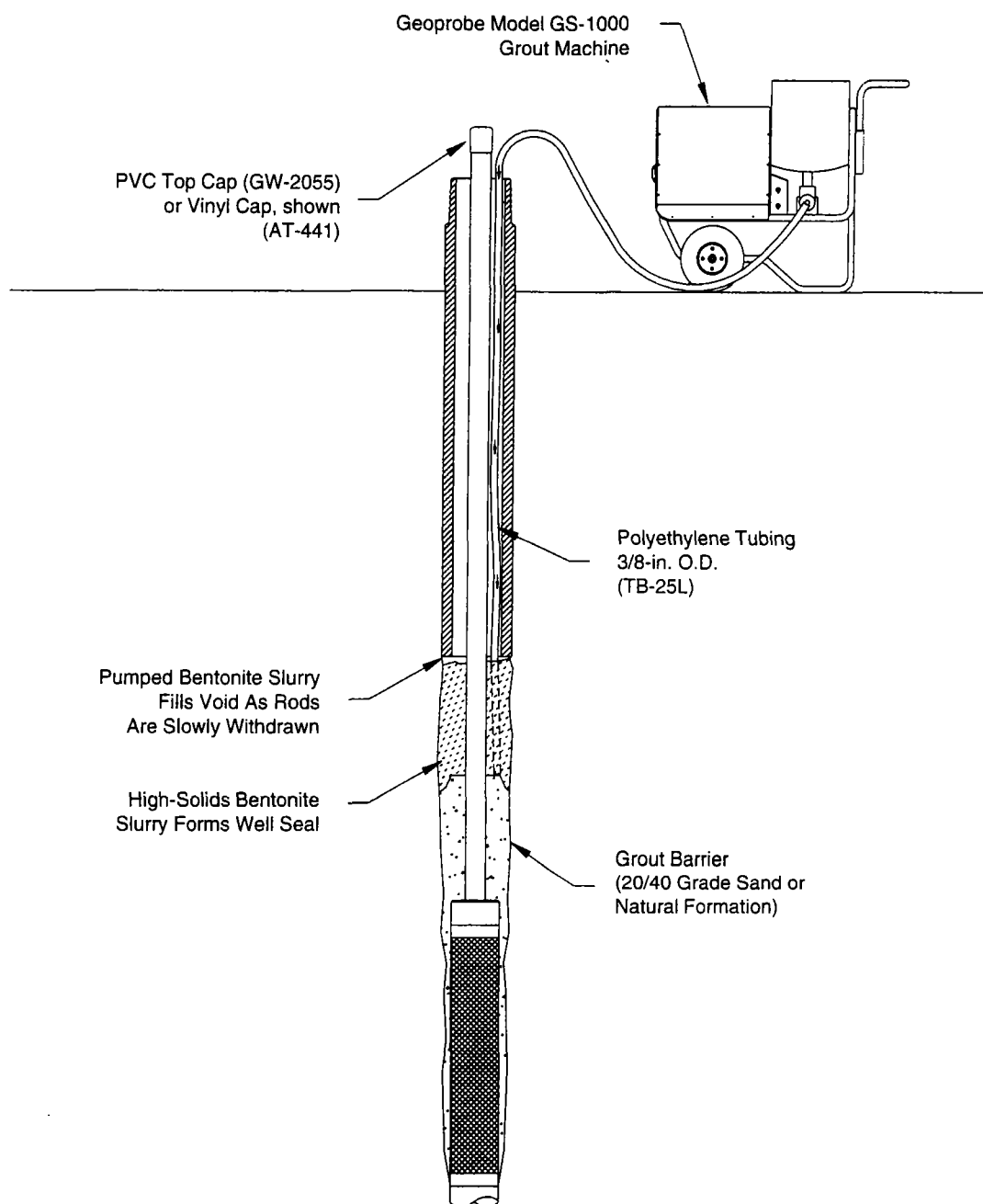


FIGURE 4.9
Providing Bentonite Seal With Geoprobe Model GS-1000 Grout Machine

spaces often develop when poured (gravity installed) granular bentonite is used under these conditions, resulting in an inadequate annular seal. Wet rods will often lead to bridging problems as well.

- a. Mix 1 gallon (3.8 L) of high-solids bentonite (20 to 25 percent by dry weight) and place in the hopper of the grout machine.
- b. Insert 3/8-inch poly tubing to the bottom of the annulus between the probe rods and well riser. Leaving at least 25 feet (8 m) extending from the top of the rod string, connect the tubing to the grout machine. This extra length will allow rod extraction later in the procedure.
- c. Reposition the probe unit and attach the rod grip puller.
- d. Activate the pump and fill the poly tubing with bentonite. Begin slowly pulling the rod string approximately 3 feet (1 m) while operating the pump (Fig. 4.9). This will place bentonite in the void left by the retracted rods before it is filled by the collapsing formation. Continue to watch that the PVC riser does not come up with the rod string.

When removing the retracted probe rod, slide the rod over the poly tubing and place it on the ground next to the grout machine. This eliminates cutting and reattaching the tubing for each rod removed from the string. Take care not to "kink" the tubing during this process as it will create a weak spot in the tubing which may burst when pressure is applied.

- e. Measure the annulus depth to ensure that at least 2 feet (0.6 m) of bentonite was delivered. Pump additional bentonite slurry if needed.

4.4 Grouting Well Annulus

The placement of grout material within the remaining well annulus provides additional protection from vertical contaminant migration. Most grout mixes are composed of neat cement, high-solids bentonite slurry, or a combination of cement and bentonite. Such mixes must be delivered with a high-pressure grout pump. When stable formations exist, the well may be sealed by pouring dry granular bentonite directly into the annulus from the ground surface. Consult the appropriate regulatory agency to determine approved grouting methods.

This section presents the procedure for grouting the well annulus with the Geoprobe Model GS-1000 Grout Machine. Refer to Figure 4.10 as needed.

1. Mix an appropriate amount of grout material and place it in the hopper on the grout machine.

NOTE: It is recommended that an additional 25 to 50 percent of the calculated annulus volume is included in the total grout volume. This allows for material that is left in the grout hose and tubing or moves into the formation during pumping. An approximate range is 0.20 to 0.25 gallons (0.8 to 0.9 L) of grout for each foot of riser below ground surface.

2. Insert 3/8-inch poly tubing into the well annulus until the end of the tubing reaches the top of the bentonite seal. Leaving at least 25 feet (8 m) extending from the top of the rod string, cut the tubing from the roll. This extra length allows rod extraction with the tubing attached to the pump. If tubing was used to install the bentonite seal, it may be reused for the application of grout.

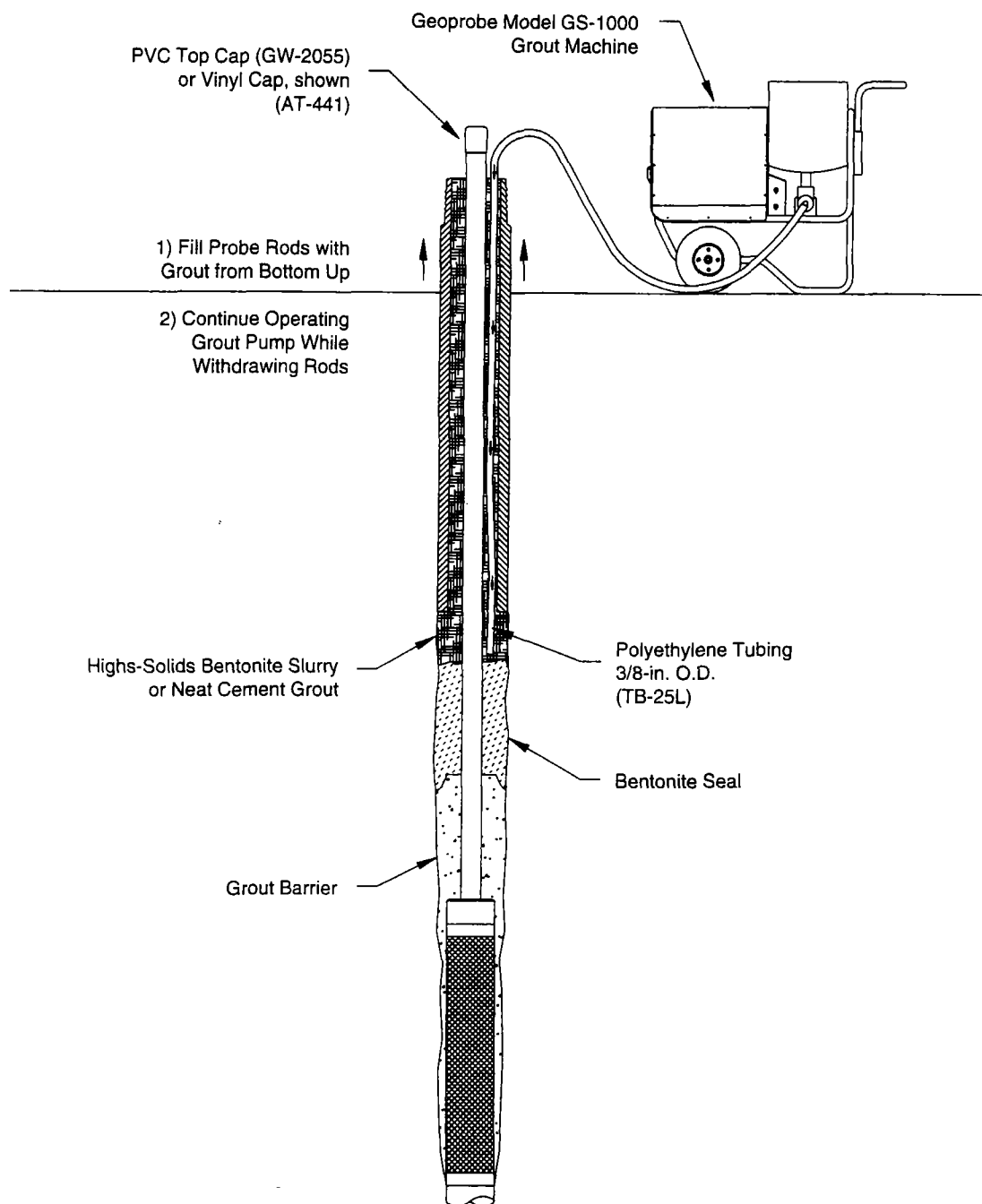


FIGURE 4.10
Grouting Well Annulus with Geoprobe Model GS-1000 Grout Machine

3. Attach the tubing to the grout machine and begin pumping. If the bentonite seal was below the water table (deep well installation), water will be displaced and flow from the probe rods as the annulus is filled with grout. Continue operating the pump until undiluted grout flows from the top probe rod.

4. Reposition the probe unit and prepare to pull rods.

5. Begin pulling the probe rods while continuing to pump grout. Match the pulling speed to grout flow so that the rods remain filled to the ground surface. This maintains hydraulic head within the probe rods and ensures that the void left by the withdrawn rods is completely filled with grout.

NOTE: Slide the probe rods over the poly tubing and place neatly on the ground next to the grout machine. Be careful not to pinch or bind the poly tubing as this forms weak spots which may burst when pressure is applied.

NOTE: Try to avoid filling the upper 12 inches (305 mm) of well annulus with grout when pulling the expendable point holder. This will make for a cleaner well cap installation.

6. When all probe rods have been retrieved and the well is adequately grouted, unstring the poly tubing and begin cleanup. It is important to promptly clean the probe rods, grout machine, and accessories. This is especially true of cement mixes as they quickly set up and are difficult to remove once dried.

4.5 Surface Cover

A surface cover protects the PVC well riser from damage and tampering. Although aboveground and flush-mount well covers may be used, most Geoprobe monitoring wells have been installed with flush-mount covers (Fig. 4.11). Consult the project planners and/or appropriate regulators to determine the approved well cover configuration for your specific application.

1. In order to fit under a flush-mount cover, the top of the well riser must be below the ground surface. Place the well cover over the riser and push it into the ground to mark the cover diameter. Remove the cover and dig out approximately 6 inches (152 mm) of soil from within the cover mark.

2. Remove the cap from the 0.5-inch PVC riser. The top of the riser should be approximately 2 inches (51 mm) above the bottom of the hole. If a joint is near this level, unthread the top riser and place a threaded PVC cap on the remaining riser. If a joint is not positioned near the specified level, cut off the riser with a pair of PVC cutters. Cut at a slight angle to make it easier to remove the cap. A vinyl cap is now required. Place the cap on the well riser. Do not apply duct tape at this time.

NOTE: Do not cut off the riser with a hacksaw as cuttings will fall down into the screens.

3. Push the 24-inch (610 mm) section of 2-inch PVC pipe over the well riser. Position the top of the 2-inch pipe 1.5 to 2.0 inches (38 to 51 mm) above the top of the riser. This will provide adequate room to install the locking cap on the 2-inch pipe and still allow removal of the riser cap.

4. Insert the locking cap into the 2-inch PVC pipe. Tighten the wing-bolt until the cap fits snugly.

5. Position the well cover so that it is centered over the PVC pipe. Push the cover into the ground using the foot of the probe unit if needed. Provide at least 0.5 inches (13 mm) of space between the top of the locking cap and bottom of the well cover lid. Do not push the cover so deep as to place the top of the lid below the surrounding ground surface.

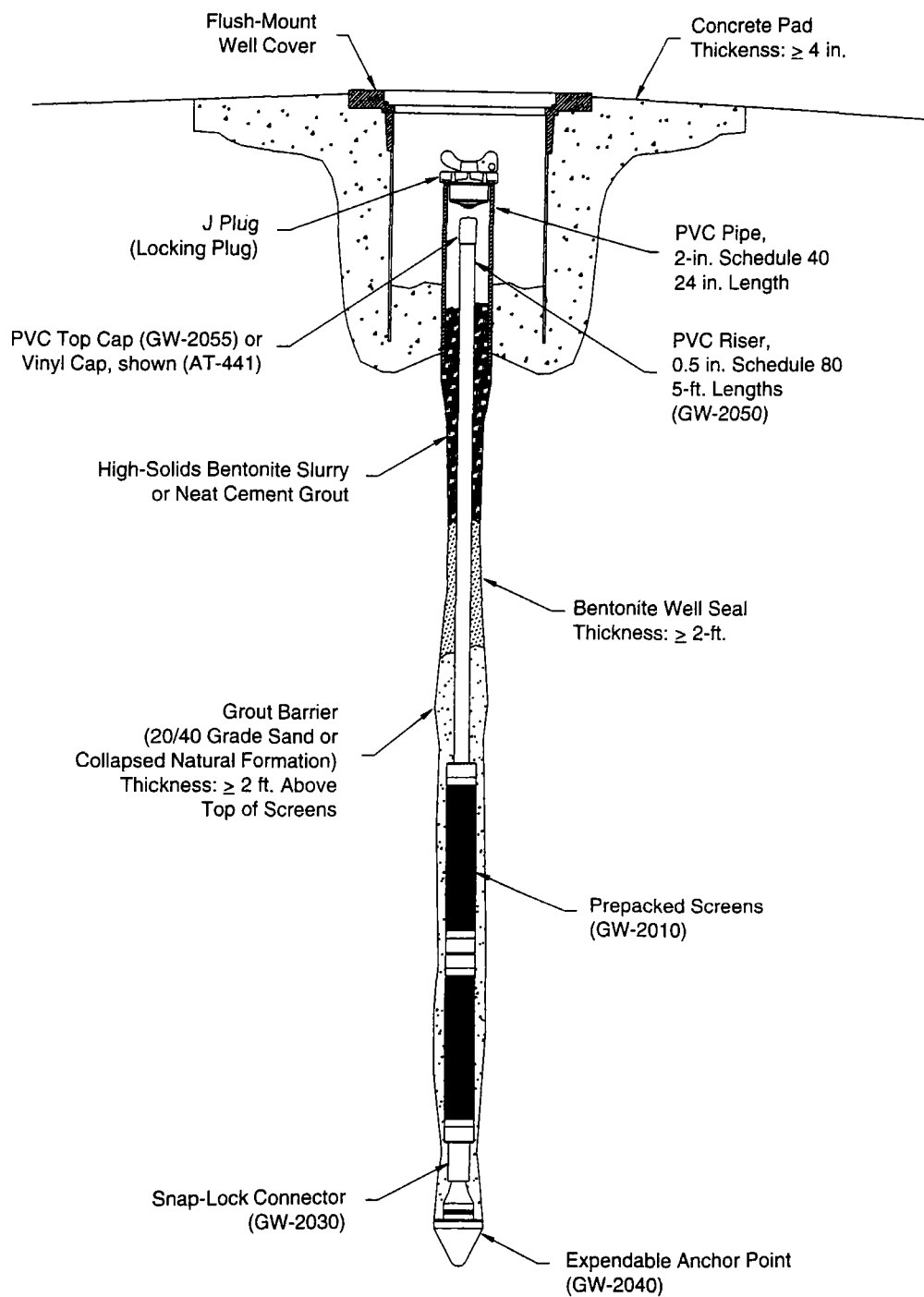


FIGURE 4.11
A Properly Installed Geoprobe Prepacked Screen Monitoring Well

6. Support the well cover by installing a concrete pad according to project requirements. Pads are commonly square-shaped with a thickness of 4 inches (102 mm) and sides measuring 24 inches (610 mm) or greater. Finish the pad so that the edges slope away from the center to prevent ponding of surface water on the well cover.
7. Fill the inside of the well cover with sand up to approximately 2 to 3 inches (51 to 76 mm) from the top of the PVC pipe with locking cap.

5.0 WELL DEVELOPMENT

“The development serves to remove the finer grained material from the well screen and filter pack that may otherwise interfere with water quality analyses, restore groundwater properties disturbed during the (probing) process, and to improve the hydraulic characteristics of the filter pack and hydraulic communication between the well and the hydrologic unit adjacent to the well screen,” (ASTM D 5092).

The two most common methods of well development are bailing or pumping (purging) and mechanical surging.

Purging involves removing at least three well volumes of water with either a Tubing Bottom Check Valve (GW-42) or a Stainless Steel Mini-Bailer Assembly (GW-41). Include the entire 2.125-inch (54 mm) diameter of disturbed soil at the screen interval when calculating the well volume.

Mechanical Surging utilizes a surge block which is attached to extension rods and lowered inside the riser to the screen interval. The extension rods and surge block are moved up and down, forcing water into and out of the screen. A tubing bottom check valve is then used to remove the water and loosened sediments (Fig. 4.12).

NOTE: Mechanical surging may damage the well screen and/or reduce groundwater flow across the filter pack if performed incorrectly or under improper conditions. Refer to ASTM D 5521, “Standard Guide for Development of Groundwater Monitoring Wells in Granular Aquifers” for a detailed discussion of mechanical surging.

Development should continue until consecutive samples yield representative water. “Representative water is assumed to have been obtained when pH, temperature, and specific conductivity readings stabilize and the water is visually clear of suspended solids,” (ASTM D 5092).

6.0 SAMPLE COLLECTION

Groundwater samples are easily obtained with a tubing bottom check valve (with 3/8-inch O.D. tubing as shown in Fig. 4.12) or a stainless steel mini-bailer assembly. While the check valve is the quicker and more economical sampling device, some operators still prefer the traditional mini-bailer.

NOTE: The up and down motion of the check valve can introduce significant error when collecting samples for volatiles analysis. To avoid volatiles loss, lower the check valve and tubing to the target monitoring zone without the check ball. Drop the check ball to the bottom of the tubing from the ground surface. This seals the check valve and captures the sample inside the tubing without stripping away volatiles. To collect the sample, simply retrieve the tubing from the well riser, remove the check valve, and place the groundwater in an approved container.

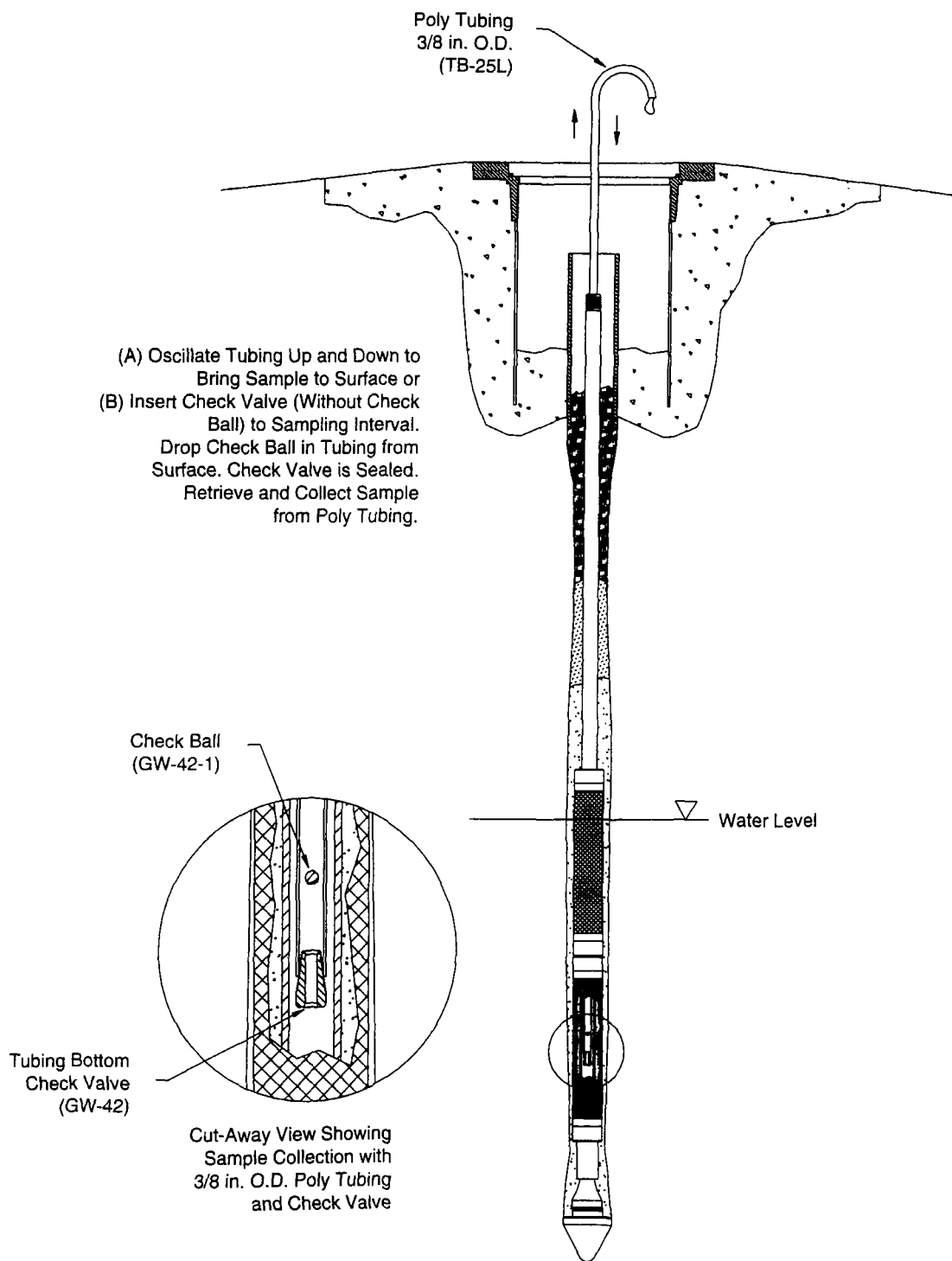


FIGURE 4.12
Sampling With Polyethylene Tubing and a Tubing Bottom Check Valve

SECTION 17.01

ATTACHMENT C

**GEOPROBE LARGE BORE
SOIL SAMPLER**

THIS ATTACHMENT IS NOT AVAILABLE ELECTRONICALLY

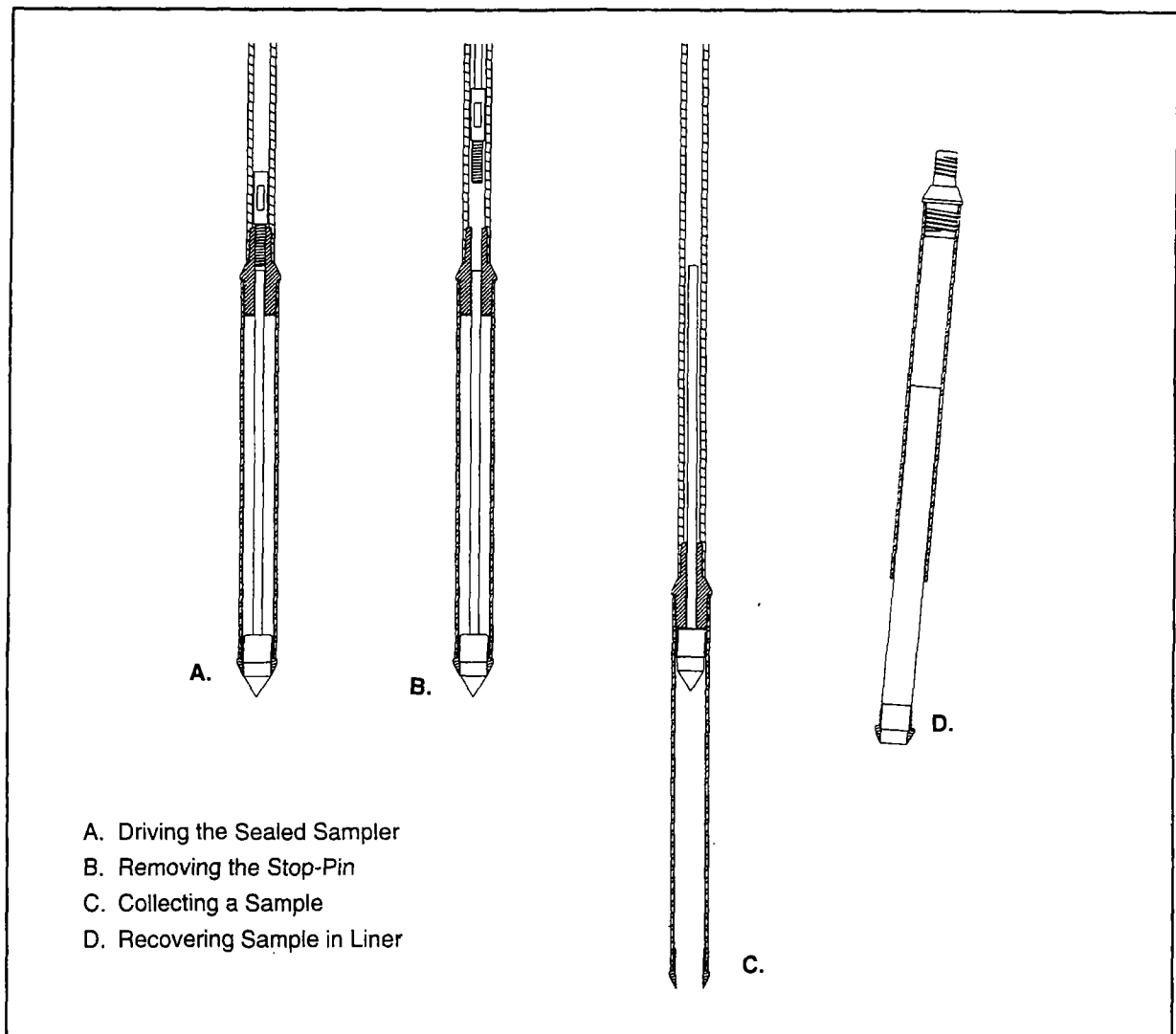
GEOPROBE LARGE BORE SOIL SAMPLER

DISCRETE INTERVAL SOIL SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 93-660

September, 1996



DRIVING AND SAMPLING WITH THE LARGE BORE SOIL SAMPLER

1.0 OBJECTIVE

The objective of this procedure is to collect a discrete soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

Geoprobe® Soil Probing Machine: A vehicle-mounted, hydraulically-powered machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

** Geoprobe® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas*

Large Bore Soil Sampler: A 24-inch long x 1-1/2-inch (610 mm x 38 mm) diameter soil sampler capable of recovering a discrete sample that measures up to 320 ml in volume in the form of a 22-inch x 1-1/16-inch (559 mm x 27 mm) core contained inside a removable liner.

Liner: A 24-inch long x 1-1/8-inch diameter (610 mm x 29 mm) removable/replaceable, thin-walled tube inserted inside the Large Bore Sample Tube for the purpose of containing and storing soil samples. Liner materials include brass, stainless steel, Teflon®, and clear plastic (cellulose acetate butyrate).

2.2 Discussion

The Large Bore (LB) Soil Sampler is used primarily as a discrete interval sampler; that is, for the recovery of a sample at a prescribed depth. In certain circumstances, it is also used for continuous coring.

The assembled Large Bore Sampler is connected to the leading end of a Geoprobe brand probe rod and driven into the subsurface using a Geoprobe Soil Probing Machine. Additional probe rods are connected in succession to advance the sampler to depth. The sampler remains sealed (closed) by a piston tip as it is being driven. The piston is held in place by a reverse-threaded stop-pin at the trailing end of the sampler. When the sampler tip has reached the top of the desired sampling interval, a series of extension rods, sufficient to reach depth, are coupled together and lowered down the inside diameter of the probe rods. The extension rods are then rotated clockwise (using a handle). The male threads on the leading end of the extension rods engage the female threads on the top end of the stop-pin, and the pin is removed. After the extension rods and stop-pin have been removed, the tool string is advanced an additional 24 inches. The piston is displaced inside the sampler body by the soil as the sample is cut. To recover the sample, the sampler is retrieved from the hole and the liner containing the soil sample is removed. The operation is illustrated in Figure 1.

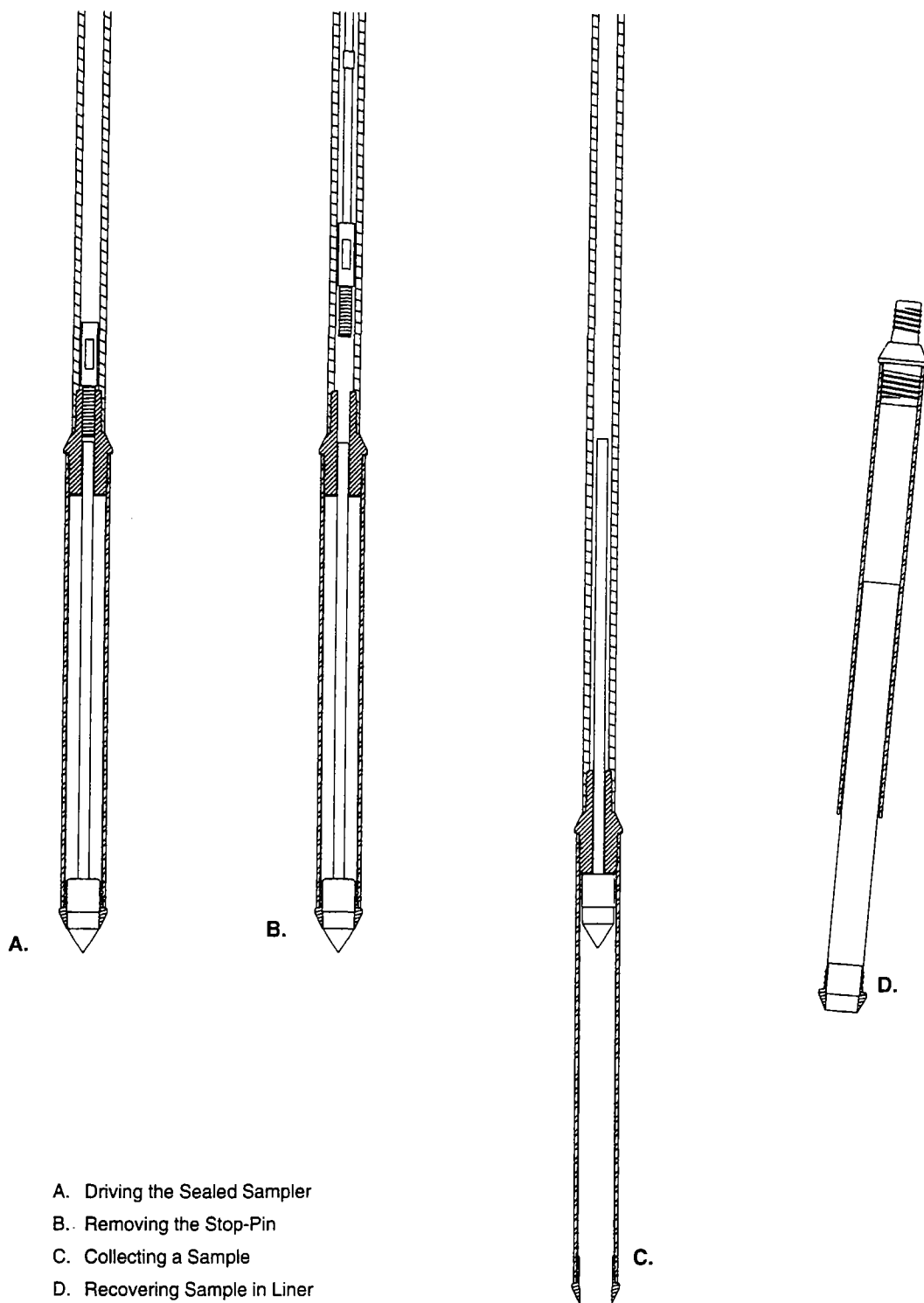


FIGURE 1
Driving and Sampling with the Large Bore Soil Sampler

3.0 REQUIRED EQUIPMENT

The following equipment is required to recover soil cores using the Geoprobe Large Bore Soil Sampler (Fig. 2) and driving systems. Note that the sample liners for the Large Bore Sampler are available in four different materials. Liner materials should be selected based on sampling purpose, analytical parameters, and data quality objectives.

LARGE BORE SAMPLER PARTS	QUANTITY	PART NUMBER
LB Heavy-Duty Cutting Shoe	-1-	AT-6601
LB Heavy-Duty Drive Head, fits 1.25-inch probe rods	-1-	AT-6612
LB Heavy-Duty Sample Tube	-1-	AT-6621
LB Piston Tip	-1-	AT-663
LB Piston Rod	-1-	AT-664
LB Clear CAB Liner	variable	AT-665K
LB Brass Liner	variable	AT-666
LB Stainless Steel Liner	variable	AT-667
LB Teflon® Liner	variable	AT-668
LB Cutting Shoe Wrench	-1-	AT-669
Vinyl End Caps	variable	AT-641K
LB Piston Stop-Pin	-1-	AT-63
LB Piston Stop-Pin O-Ring	variable	AT-63R
Teflon® Tape (optional)	variable	AT-640T
Nylon Brush for LB Tubes	-1-	BU-600
GEOPROBE TOOLS*	QUANTITY	PART NUMBER
Drive Cap, fits 1.25-inch probe rod	-1-	AT-1200
Pull Cap, fits 1.25-inch probe rod	-1-	AT-1204
Probe Rod, 1.25 inch x 12 inches	-1-	AT-1212
Probe Rod, 1.25 inch x 24 inches	-1-	AT-1224
Probe Rod, 1.25 inch x 36 inches (optional)	Variable	AT-1236
Probe Rod, 1.25 inch x 48 inches	Variable	AT-1248
Extension Rod, 36 inch (optional)	Variable	AT-67
Extension Rod, 48 inch	Variable	AT-671
Extension Rod Centering Plug	-2-	AT-6712
Extension Rod Coupler	Variable	AT-68
Extension Rod Handle	-1-	AT-69
Extension Rod Jig	-1-	AT-690
Extension Rod Quick Links (Optional)	Variable	AT-694K
LB Sampler Manual Extruder Kit	-1-	AT-659K
ADDITIONAL TOOLS	QUANTITY	
Locking Pliers	-1-	
Adjustable Open-End Wrench, 1-1/4 inch or	-1-	
MC Combination Wrench	-1-	AT-8590
Open-End Wrench, 3/8 inch	-1-	
Pipe Wrench	-2-	

* Probe rods and accessories are also available in 1-inch O.D. (outside diameter).

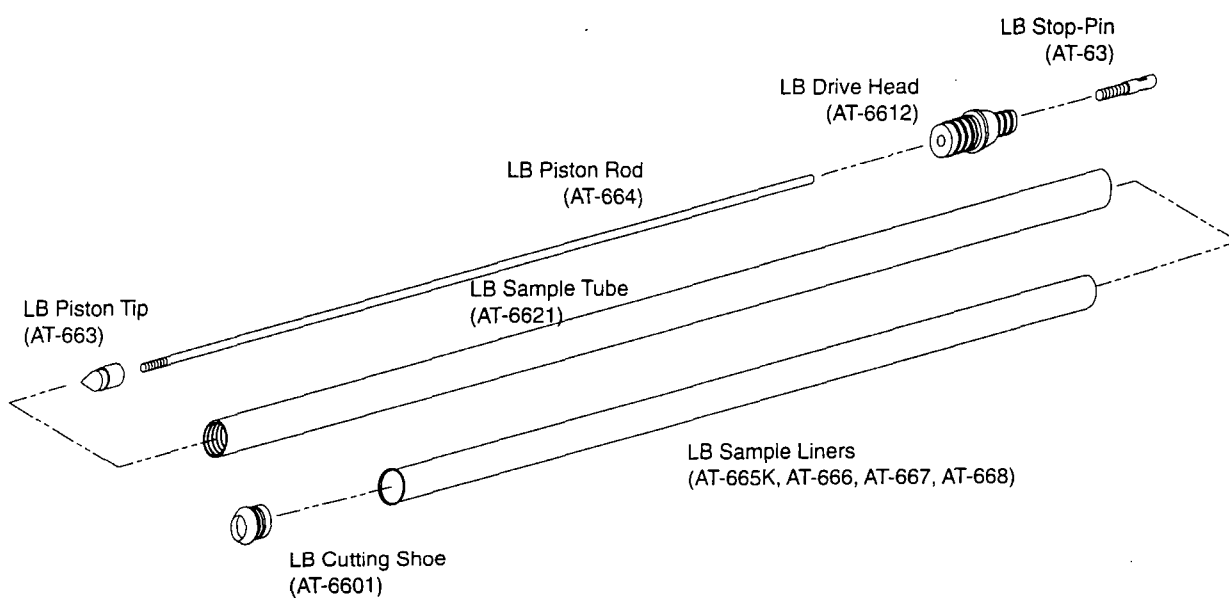


FIGURE 2
Large Bore Soil Sampler Parts

1.0 OPERATION

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to specific project requirements. A clean, new liner is recommended for each use. Parts should also be inspected for wear or damage at this time.

4.2 Assembly

1. Install a new AT-63R O-Ring into the O-Ring groove on the stop-pin.
2. Seat the pre-flared end of the LB liner over the interior end of the cutting shoe as shown in Fig. 3. It should fit snugly.
3. Insert the liner into either end of the sample tube and screw the cutting shoe and liner into place. If excessive resistance is encountered during this task, it may be necessary to use the LB shoe wrench. Place the wrench on the ground and position the sampler assembly with the shoe end down so that the recessed notch on the cutting shoe aligns with the pin in the socket of the wrench (Fig. 4). Push down on the sample tube while turning it until the cutting shoe is threaded tightly into place.
4. Screw the piston rod into the piston tip. Insert the piston tip and rod into the sample tube from the end opposite the cutting shoe. Push and rotate the rod until the tip is seated completely into the cutting shoe.
5. Screw the drive head onto the top end of the sample tube, aligning the piston rod through the center bore.
6. Screw the reverse-threaded stop-pin into the top of the drive head and turn it **counterclockwise** with a 3/8-inch wrench until securely tightened (Fig. 5). Hold the drive head in place with a 1-1/4-inch or adjustable wrench while completing this task to assure that the drive head stays completely seated. The Macro-Core® Combination Wrench will also fit the drive head for 1.25-inch probe rods. The assembly is now complete.

4.3 Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sands, or rubble. Pre-probing will prevent unnecessary wear on the sampling tools. A Large Bore Pre-Probe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval. Where surface pavements are present, a hole may be drilled with the Geoprobe Soil Probing Machine using a drill steel (AT-3524, AT-3536, or AT-3548 depending upon the thickness of the pavement), tipped with a 1.5-inch diameter carbide drill bit (AT-36) prior to probing.

NOTE: Some soil conditions may warrant using a solid drive point (AT-142B) to pre-probe the hole to the desired sampling depth. Information about the subsurface and depth to bedrock should be known before driving the sampler. Damage may occur if the sampler is driven into rock or other impenetrable material.

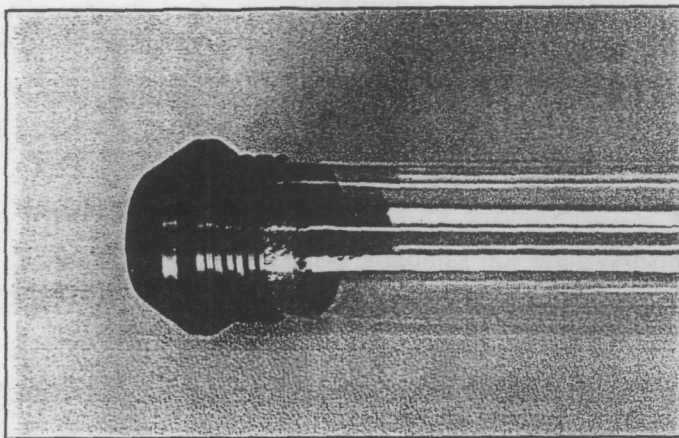


Figure 3. Liner fits snugly over interior end of cutting shoe.

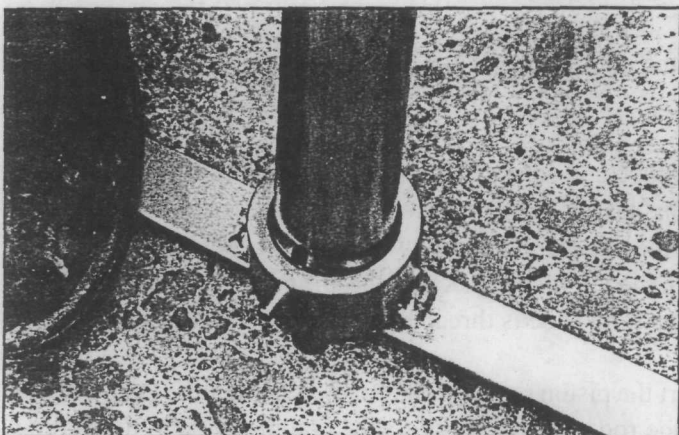


Figure 4. Using the AT-669 Cutting Shoe Wrench to attach cutting shoe.



Figure 5. Tightening the Stop-pin.



Figure 7. Coupling Extension Rods together.

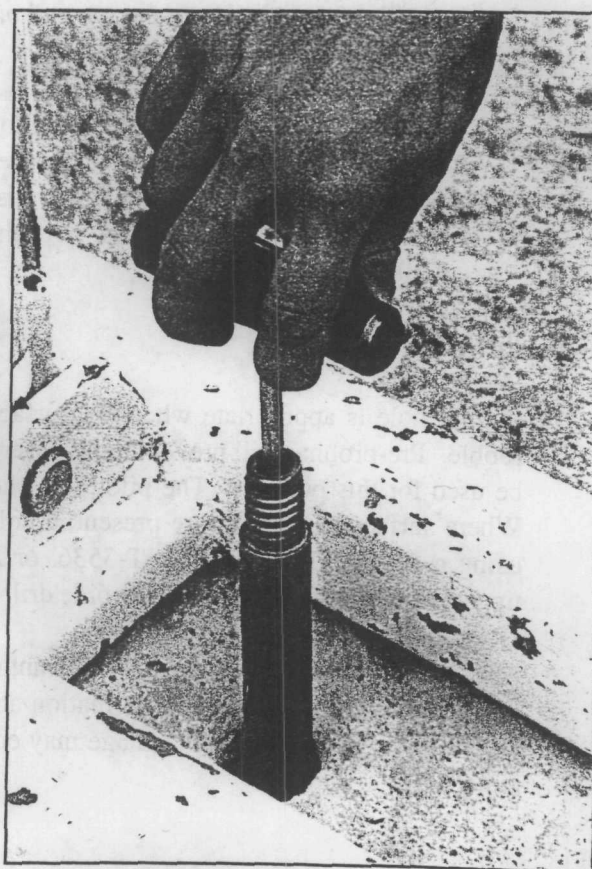


Figure 8. Rotating the Extension Rod Handle.

4.4 Driving

1. Attach a drive cap to a one-foot probe rod and thread the rod onto the assembled sampler. Position the assembly for driving into the subsurface.
2. Drive the assembly into the subsurface until the drive head on the sample tube is just above the ground surface.
3. Remove the drive cap and one-foot probe rod. Secure the drive head with a 1-1/4-inch open-end, adjustable wrench or a Macro-Core® combination wrench, and re-tighten the stop-pin with a 3/8-inch open-end wrench (Fig. 5).
4. Attach the drive cap to a two-foot probe rod and continue driving the sampler into the ground. Attach three- or four-foot probe rods in succession until the leading end of the sampler reaches the top of the desired sampling interval.

4.5 Preparing to Sample

1. When sampling depth has been reached, position the Geoprobe machine away from the top of the probe rod to allow room to work.
2. Insert an extension rod down the inside diameter of the probe rods. Hold onto it and place an extension rod coupler or Quick Link extension rod connectors (Fig. 6) on the top threads of the extension rod (the downhole end of the leading extension rod should remain uncovered). Attach another extension rod to the coupler and lower the jointed rods down hole (Fig. 7). An extension rod jig (Fig. 6) may be used to help hold the rods during Steps 2 and 3.
3. Couple additional extension rods together in the same fashion as in Step 2. The leading extension rod must reach the stop-pin at the top of the sampler assembly. When coupling extension rods together, you may opt to use the extension rod jig to hold the downhole extension rods while adding additional rods.
4. When the leading extension rod has reached the stop-pin down hole, attach the extension rod handle to the top extension rod.
5. Turn the handle **clockwise** until the stop-pin detaches from the threads on the drive head (Fig. 8). Pull up lightly on the extension rods during this procedure to check thread engagement.

NOTE: The larger inside diameter (I.D.) of the 1-1/4-inch probe rods can make it difficult to engage the stop-pin. To remedy this problem, attach an Extension Rod Center Plug to the bottom of the first extension rod. Another centering plug may be necessary between the first and second extension rods if the extension rods are slightly bent.

6. Remove the extension rods and uncouple the sections as each joint is pulled from the hole. The extension rod jig may be used to hold the rod couplers in place as the top extension rods are removed.
7. The stop-pin should be attached to the bottom of the last extension rod upon removal. Inspect it for damage. Once the stop-pin has been removed, the sampler is ready to be driven to collect a sample.

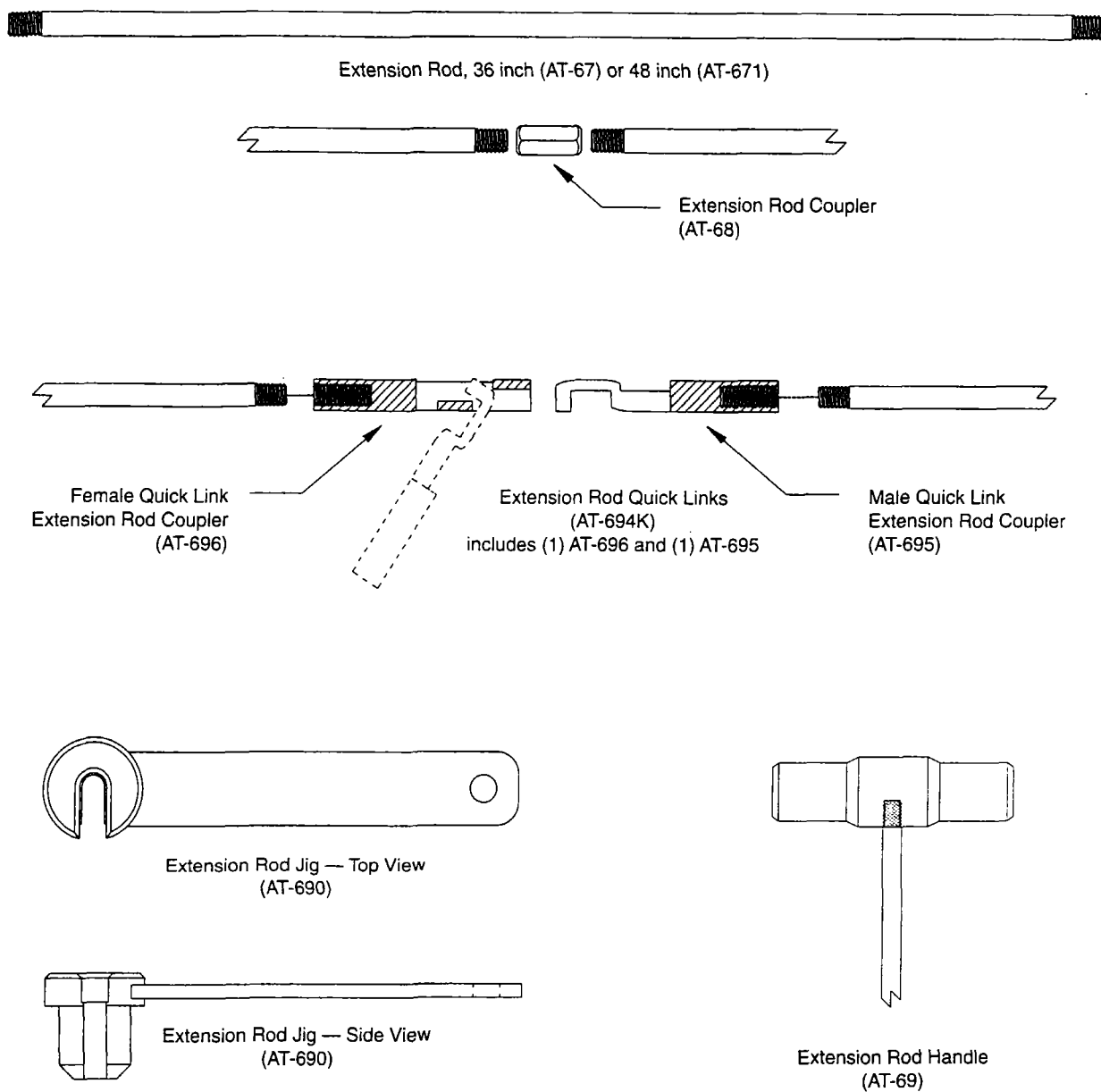


FIGURE 6
Geoprobe Extension Rods and Accessories

4.6 Sample Collection

1. Reposition the Geoprobe machine over the probe rods, adding an additional probe rod to the tool string if necessary. Make a mark on the probe rod 24 inches above the ground surface (this is the distance the tool string will be advanced).
2. Attach a drive cap to the probe rod and drive the tool string and sampler another 24 inches. Activate the hammer function during sample collection to increase sample recovery. Do not over-drive the sampler.

4.7 Retrieval

1. Remove the drive cap from the top probe rod and attach a pull cap. Lower the hammer assembly and close the hammer latch over the pull cap.
2. With the machine foot firmly on the ground, pull the tool string out of the hole. Stop when the top (drive head) of the sampler is about 12 inches above the ground surface.
3. Because the piston tip and rod have been displaced inside the sample tube, the piston rod now extends into the two-foot probe rod section. In loose soils, the two-foot probe rod and sampler may be recovered as one piece by using the Foot Control on the probe machine to lift the sampler the remaining distance out of the hole.
4. If excessive resistance is encountered while attempting to lift the sampler and probe rod out of the hole using the Foot Control, unscrew the drive head from the sampler and remove it with the probe rod, the piston rod, and the piston tip. Replace the drive head onto the sampler and attach a pull cap to it. Lower the hammer assembly and close the hammer latch over the pull cap and pull the sampler the remaining distance out of the hole with the probe machine foot firmly on the ground.

4.8 Sample Recovery

1. Detach the two-foot probe rod if it has not been done previously.
2. Unscrew the cutting shoe using the LB Cutting Shoe Wrench, if necessary. Pull the cutting shoe out with the liner attached (Fig. 9). If the liner doesn't slide out readily with the cutting shoe, take off the drive head and push down on the side wall of the liner. The liner and sample should slide out easily.

4.9 Core Liner Capping

1. The ends of the liners can be capped off using the vinyl end caps for further storage or transportation. A black end cap should be used at the bottom (down end) of the sample core and a red end cap at the top (up end) of the core.
2. On brass, stainless steel, and Teflon® liners, cover the end of the sample tube with AT-640T Teflon® tape before placing the end caps on the liner (Fig. 10). The tape should be smoothed out and pressed over the end of the soil core so as to minimize headspace. However, care should be taken not to stretch and therefore thin the Teflon® tape.

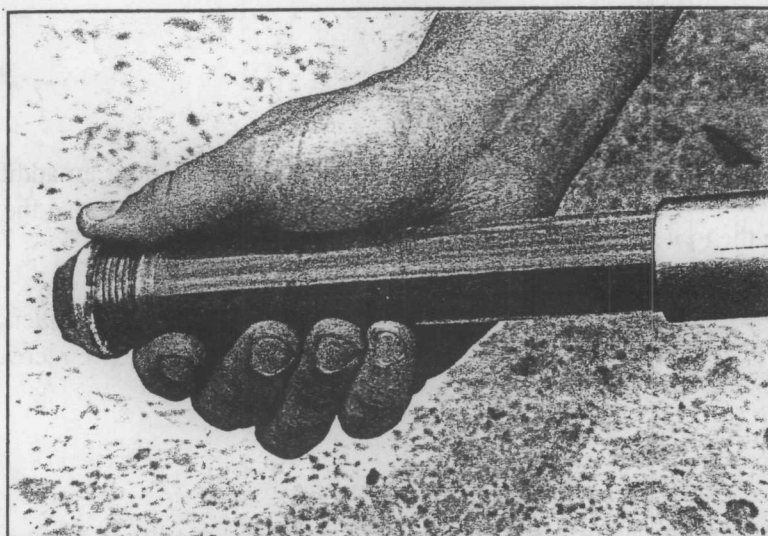


Figure 9. Removing the liner to recover the Sample.

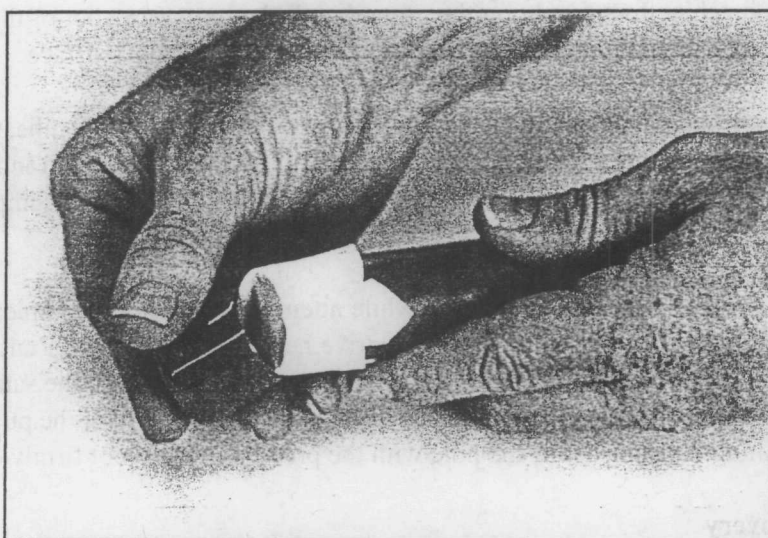


Figure 10. Covering the liner end with Teflon tape for capping.

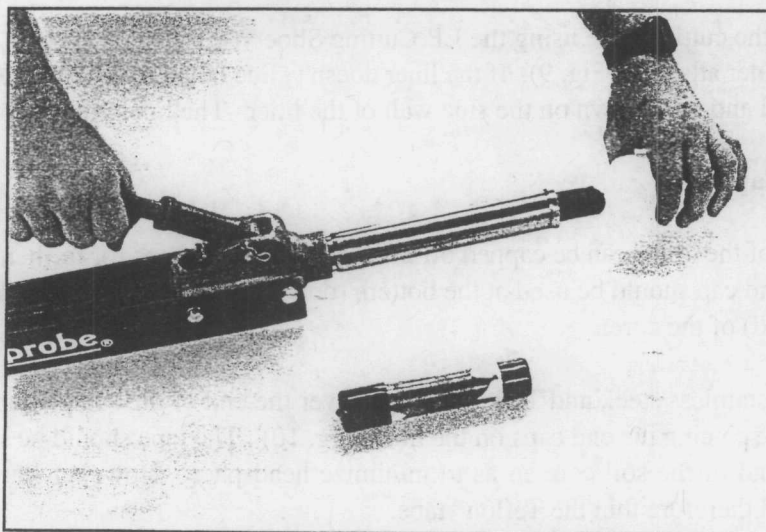


Figure 11. Extruding a sample in a metal liner using the AT-659K manual extruder.

4.10 Sample Removal

1. Large Bore clear plastic liners and Teflon® liners can be slit open easily with a hooked-blade utility knife for the samples to be analyzed or placed in appropriate containers.
2. Large Bore brass and stainless steel liners come with plastic cladding on the outside of the liner to keep four 6-inch sections aligned. Remove the cladding and cut the sections apart with a knife. The Large Bore Manual Extruder may be used to push the soil cores out of the liner sections for analysis or for transfer to other containers (Fig. 11).

CAUTION: Use extreme care when using the Large Bore Manual Extruder. Gradually apply down pressure on slow speed. Use of excessive force could result in injury to the operator or damage of the tools.

SECTION 17.01

ATTACHMENT D

**GEOPROBE MACRO-CORE
SOIL SAMPLER**

THIS ATTACHMENT IS NOT AVAILABLE ELECTRONICALLY

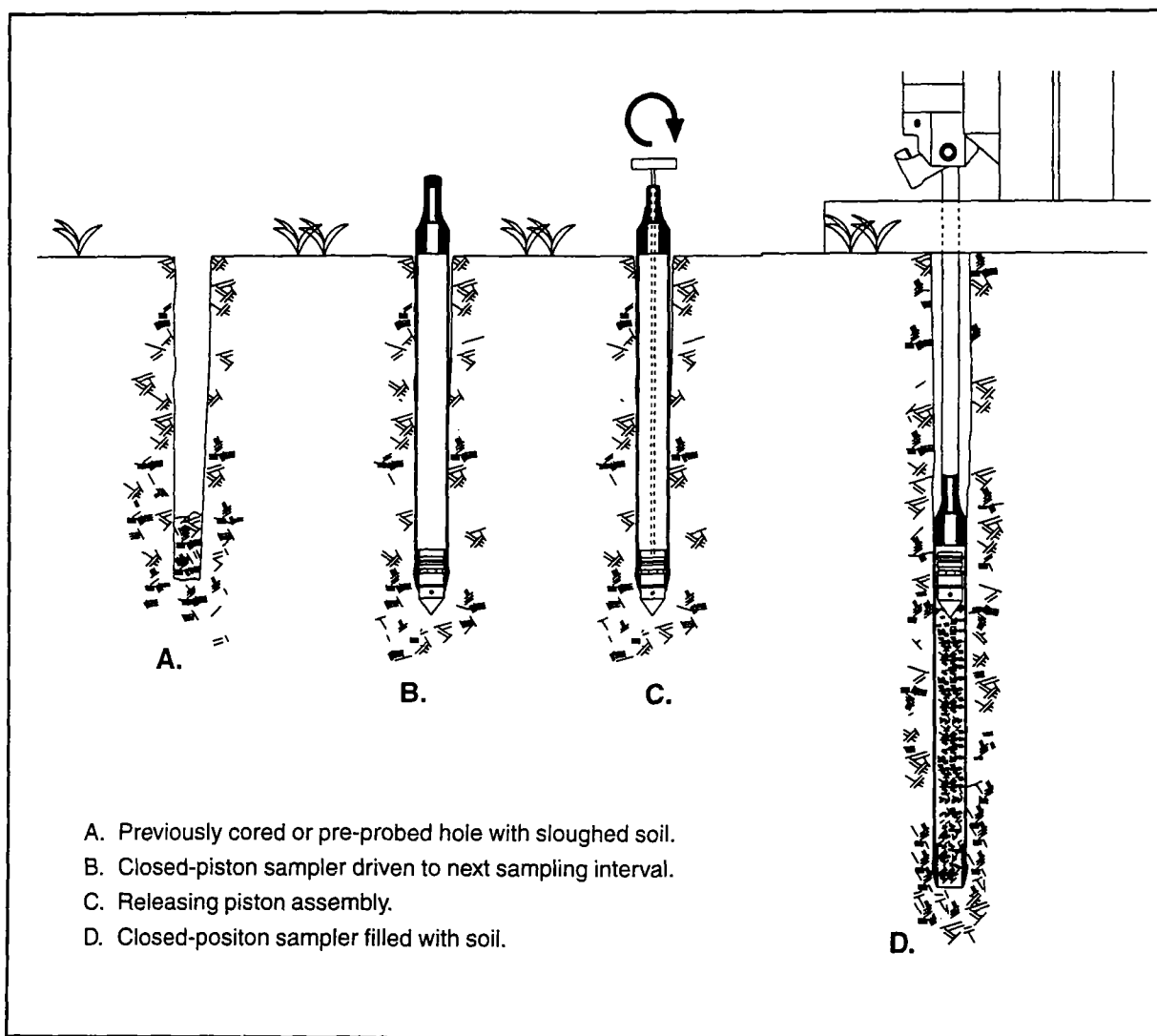
GEOPROBE MACRO-CORE® SOIL SAMPLER

STANDARD OPERATING PROCEDURE

Technical Bulletin No. 95-8500

PREPARED: November, 1995

REVISED: September, 1996



SAMPLING WITH THE MACRO-CORE® CLOSED-PISTON SOIL SAMPLER

1.0 OBJECTIVE

The objective of this procedure is to collect a soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

Geoprobe® Soil Probing Machine: A vehicle-mounted, hydraulically-powered machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or groundwater samples.

** Geoprobe is a registered trademark of Kejr Engineering, Inc., Salina, Kansas*

Macro-Core® Soil Sampler*: A 48-inch long x 2.0-inch diameter (1219 mm x 51 mm) soil sampler capable of recovering a sample that measures up to 1300 ml in volume in the form of a 45-inch x 1.5-inch (1143 mm x 38 mm) core. The Macro-Core® Sampler may be used for open-tube as well as closed-piston sampling.

** Macro-Core® is a registered trademark of Kejr Engineering, Inc., Salina, Kansas*

Liner: A 46-inch long x 1.75-inch diameter (1168 mm x 44 mm) removable/replaceable, thin-walled tube inserted inside the Macro-Core® sample tube for the purpose of containing and storing soil samples. Liner materials include stainless steel, Teflon®, PVC, and PETG.

2.2 Discussion

In this procedure, the assembled Macro-Core Soil Sampler is attached to the leading end of a Geoprobe probe rod and driven into the subsurface using a Geoprobe soil probing machine. Additional probe rods are connected in succession to advance the sampler to depth. The Macro-Core Sampler may be used as an open-tube or closed-piston sampler.

The simplest and most common use of the Macro-Core Sampler is as an open-tube sampler (Fig. 2.1A). In this method, coring starts at the ground surface with an open-ended sampler. From the ground surface, the Macro-Core Sampler is advanced 48 inches (1219 mm) and retrieved from the hole with the first soil core. In stable soils, the open-tube sampler is inserted back down the same hole to obtain the next core. Geoprobe operators have reported coring to depths exceeding 30 feet (9 m) with this method.

In unstable soils which tend to collapse into the core hole, the Macro-Core Sampler can be equipped with a closed piston assembly (Fig. 2.1B). This assembly actually locks into the cutting shoe and prevents soil from entering the sampler as it is advanced in the existing hole.

The Macro-Core Closed-Piston Sampler is not designed to be driven through undisturbed soil. Soil is first removed to sampling depth with an open-tube sampler, or a pilot hole may be made with a Macro-Core Pre-Probe. A closed-piston tip is then installed and the sampler is inserted or driven back down the same hole. When the leading end of the sampler reaches the top of the next sampling interval, the piston is unlocked using extension rods inserted down the inside of the probe rods.

Once the piston is relieved, the sampler is simply driven another 48 inches (1219 mm). Soil entering the sampler pushes the piston assembly to the top of the sample liner where it is retrieved upon removal of the soil liner and core.

Loose soils will sometimes fall out of the Macro-Core Sampler as it is retrieved from depth. The Macro-Core Core Catcher (Fig. 2.1) was designed to alleviate this problem. Excellent results are obtained when the core catcher (sometimes called a basket retainer) is used with saturated sands and other non-cohesive soils. A core catcher is not necessary when sampling tight soils and may actually inhibit sample recovery. Constructed of PVC, the core catcher may be used with PVC, PETG, Teflon®, and stainless steel liners.

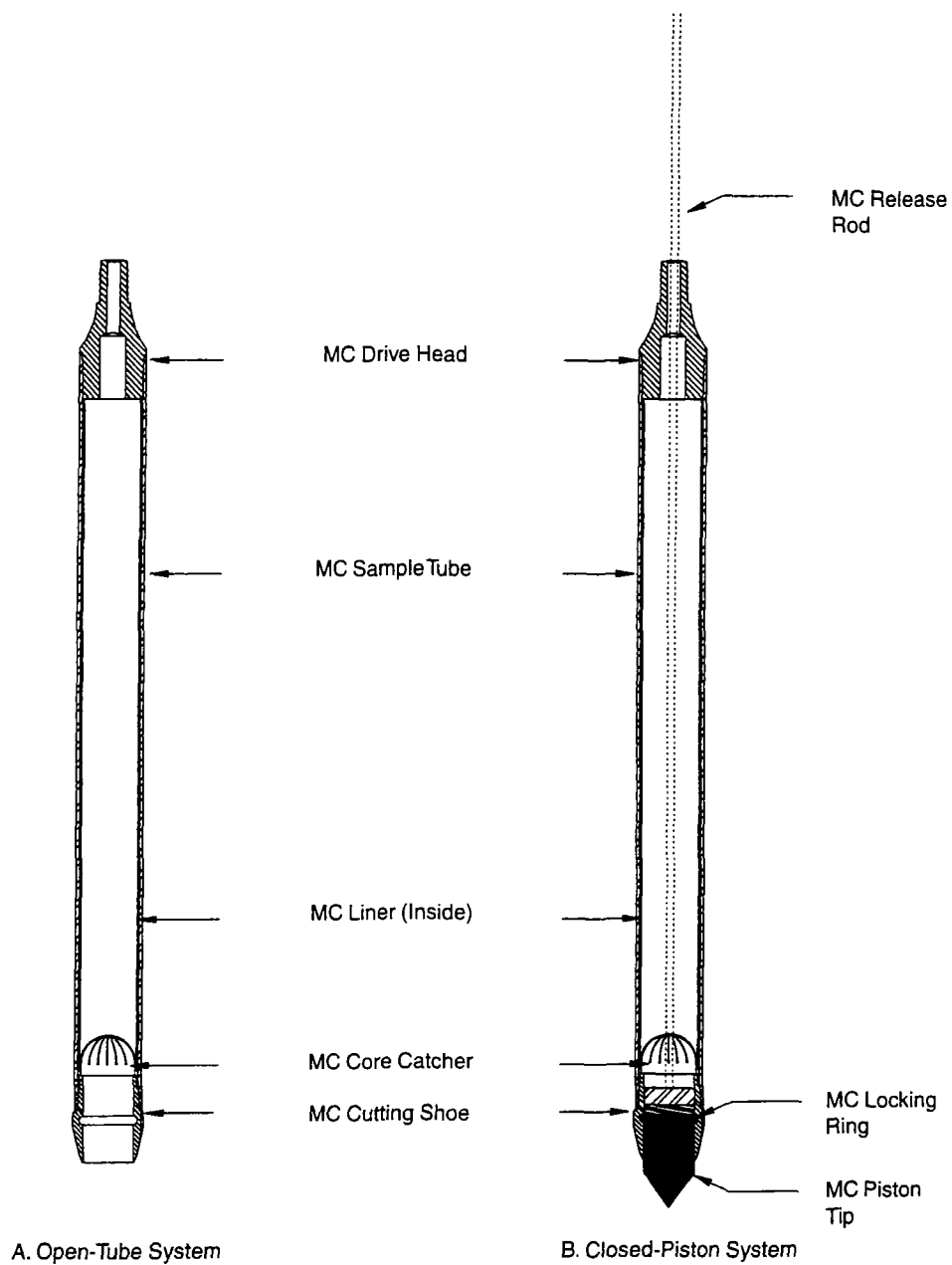


FIGURE 2.1
Macro-Core® Soil Sampler Assemblies

3.0 REQUIRED EQUIPMENT

The following equipment is required to recover soil core samples using the Geoprobe Macro-Core Soil Sampler and probing system. Note that sample liners are available in three different materials. Liner material should be selected based upon sampling purpose, analytical parameters, and data quality objectives. Figure 3.1 identifies the major components of the Macro-Core sampler.

MACRO-CORE SAMPLER PARTS*	QUANTITY	PART NUMBER
MC Drive Head, 1-inch probe rod (optional)	-1-	AT-8510
MC Drive Head, 1.25-inch probe rod	-1-	AT-8512
MC Sample Tube, Ni-plated	-1-	AT-8520
MC Sample Tube, unplated (optional)	-1-	AT-8522
MC Cutting Shoe	-1-	AT-8530
MC Cutting Shoe, heavy-duty (optional)	-1-	AT-8535
MC Cutting Shoe, 0.125 inch undersized (optional)	-1-	AT-8537
MC Piston Bolt	-1-	AT-8540
MC Piston Washer	-1-	AT-8550
MC Locking Ring Assembly	-2-	AT-8560
MC Piston Tip Assembly	-1-	AT-8570
MC Piston Release Rod	-1-	AT-8580
MC Combination Wrench	-2-	AT-8590
Nylon Brush For MC Tubes	-2-	BU-700
MACRO-CORE SAMPLER ACCESSORIES*	QUANTITY	PART NUMBER
MC Stainless Steel Liner	Variable	AT-7235
MC Teflon® Liner Assembly	Variable	AT-724
MC PETG Liner	Variable	AT-725S
MC Vinyl End Cap (black)	Variable	AT-726B
MC Vinyl End Cap (red)	Variable	AT-726R
MC Core Catcher (optional)	Variable	AT-8531
MC Spacer Ring	Variable	AT-8532
MC Locking Ring Spring	Variable	AT-8561
MC PVC Heavy-Duty Liner Assembly	Variable	AT-925S
GEOPROBE TOOLS**	QUANTITY	PART NUMBER
Drive Cap, fits 1.25-inch probe rod	-1-	AT-1200
Pull Cap, fits 1.25-inch probe rod	-1-	AT-1204
Probe Rod, 1.25 inch x 36 inches	Variable	AT-1236
Probe Rod, 1.25 inch x 48 inches	Variable	AT-1248
MC Pre-Probe, 2 inch	-1-	AT-147B
MC Pre-Probe, 2.5 inch (optional)	-1-	AT-151B
MC Pre-Probe, 3 inch (optional)	-1-	AT-152B
Extension Rod, 36 inch (optional)	Variable	AT-67
Extension Rod, 48 inch	Variable	AT-671
Extension Rod Coupler	Variable	AT-68
Extension Rod Handle	-1-	AT-69
Extension Rod Quick Links (Optional)	Variable	AT-694K
ADDITIONAL TOOLS	QUANTITY	
Locking Pliers	-1-	
Allen Wrench, 1/8 inch	-1-	
Pipe Wrench	-2-	
Hook Blade Utility Knife	-1-	

* Kits provide parts in various combinations. Parts listed are not sold separately. Refer to page 34 for a listing of available kits and specific components.

** Probe rods and accessories are also available in 1-inch O.D. (outside diameter).

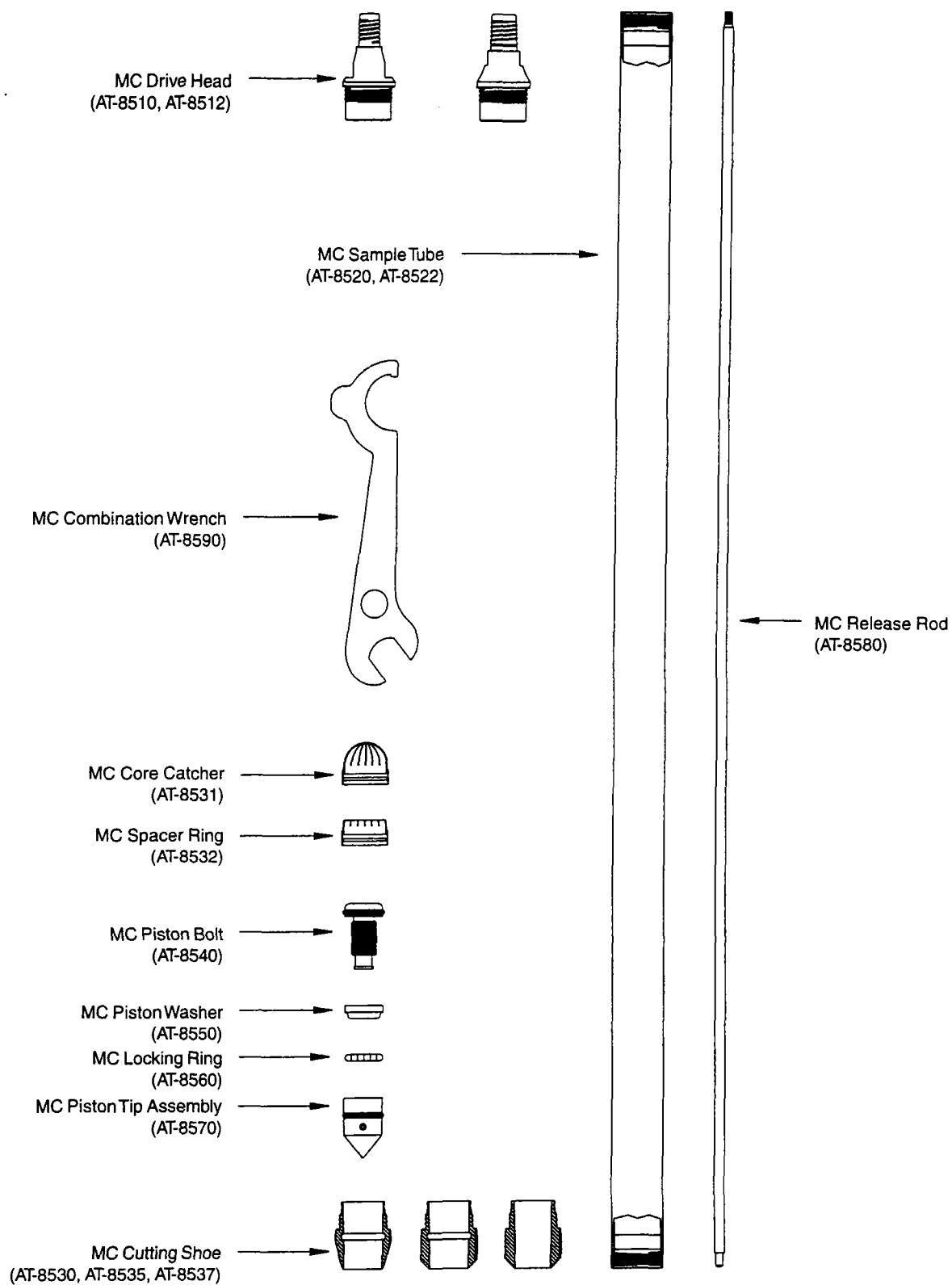


FIGURE 3.1
Macro-Core® Soil Sampler Parts

4.0 OPERATION

Size and material options have resulted in an extensive list of Macro-Core part numbers. To simplify the instructions presented in this document, part numbers are listed in the illustrations only. Refer to page 6 for a complete parts listing. Section 5 contains a complete listing of Macro-Core kits available.

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project requirements. A new, clean liner is recommended for each use if using PETG, PVC, or Teflon® liners.

Stainless Steel Liners from Geoprobe Systems are cleaned at the factory with an agitated detergent bath at a temperature of approximately 180 degrees F. After rinsing with 180-degree tap water, the liner is air dried, wrapped in PVC outer cladding, and capped with vinyl end caps.

Thoroughly clean the sampler before assembly, not only to remove contaminants but also to ensure correct operation. Dirty threads complicate assembly and may lead to sampler failure. Sand is particularly troublesome as it can bind liners in the sample tube resulting in wasted time and lost samples.

4.2 Field Blank

It is suggested that a field blank be taken on a representative sample liner prior to starting a project and at regular intervals during extended projects. Liners can become contaminated in storage. A field blank will indicate that the liners do not carry contaminants which can be transferred to soil samples. The following information is offered as an example method which may be used to take a field blank. Make the appropriate modifications for the specific analytes of interest to the investigation.

Example Procedure:

REQUIRED EQUIPMENT

MC Liner	(1)
MC Vinyl End Caps	(2)
Decontaminated Aluminum Foil Squares, 3 in. x 3 in.	(2)
Distilled Water	(100 ml)
VOA Vial (or other appropriate sample container)	(1)

1. Place a foil square and a vinyl end cap on one end of the liner.
2. Pour 100 milliliters of distilled water (or other suitable extracting fluid) into the liner.
3. Place a foil square and a vinyl end cap on the open end of the liner.
4. From the vertical position, repeatedly invert the liner so that the distilled water contacts the entire inner surface. Repeat this step for one minute.
5. Remove one end cap from the liner, empty contents into an appropriate sample container, and cap the container.
6. Perform analysis on the extract water for the analytes of interest to the investigation.

4.3 Open-Tube Sampler Assembly

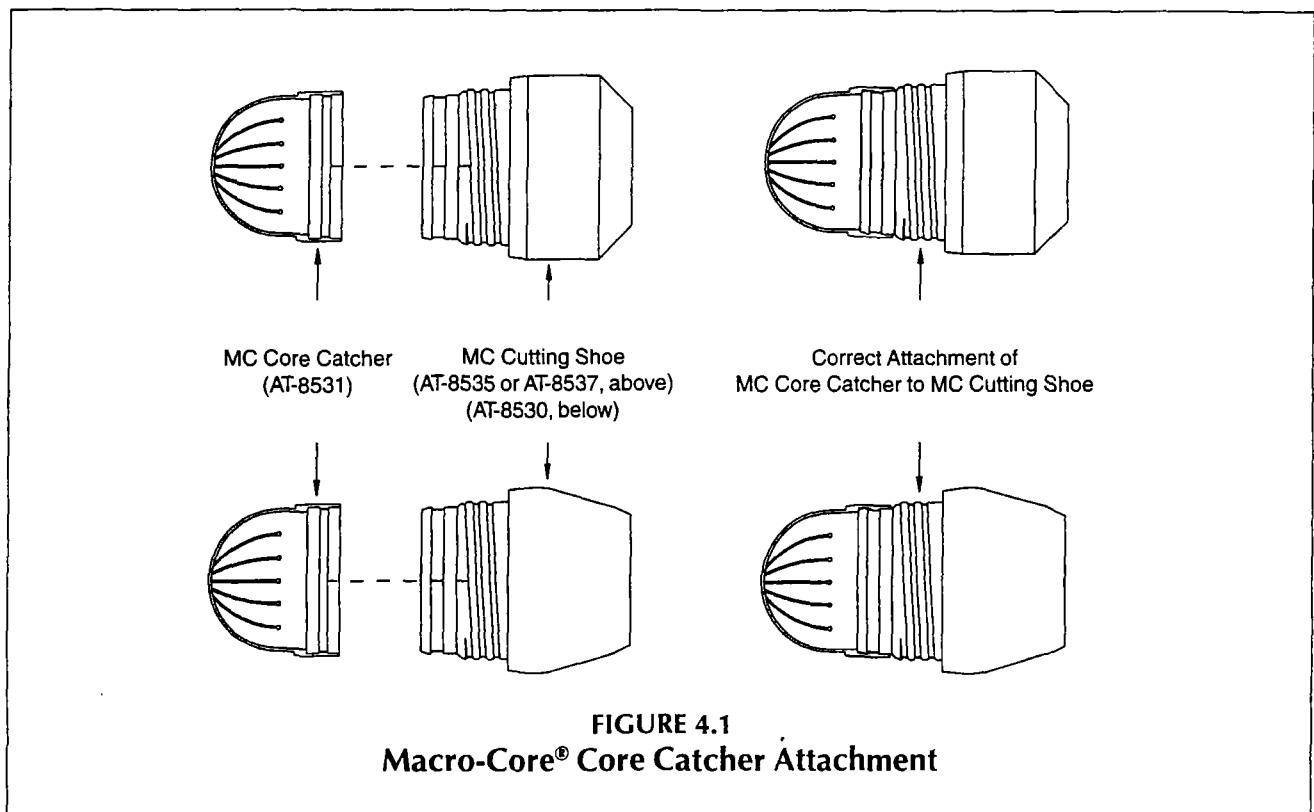
- 1a. **With MC Core Catcher.** Place the open end of an MC Core Catcher over the threaded end of an MC Cutting Shoe as shown in Figure 4.1. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT-725S (PETG) liners have a swedged end which is generally slipped directly over the groove in the cutting shoe (Fig. 4.2). To use a core catcher with these liners, simply cut approximately 0.45 inches (10 mm) of material from the swedged end of the liner and proceed to Step 2

- 1b. **Without MC Core Catcher.** Push the base of an MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place (Fig. 4.3).

NOTE: With the exception of AT-725S (PETG) liners, all liners must utilize either a spacer ring or core catcher. PETG liners have a swedged end which slides directly over the end of the cutting shoe. Attach the liner to the cutting shoe (Fig. 4.2) before proceeding to Step 2.

2. Thread the cutting shoe into one end of an MC Sample Tube (Fig. 4.4). Tighten until the end of the sample tube contacts the machined shoulder of the cutting shoe.
3. Insert the appropriate liner into the sample tube (Figure 4.4). (The liner is all ready installed if using PETG liners without a core catcher).
4. Connect an MC Drive Head to the top of the sample tube (Fig. 4.4) and securely tighten with the MC Combination Wrench (Fig. 4.5). The end of the sample tube must contact the machined shoulder of the drive head.



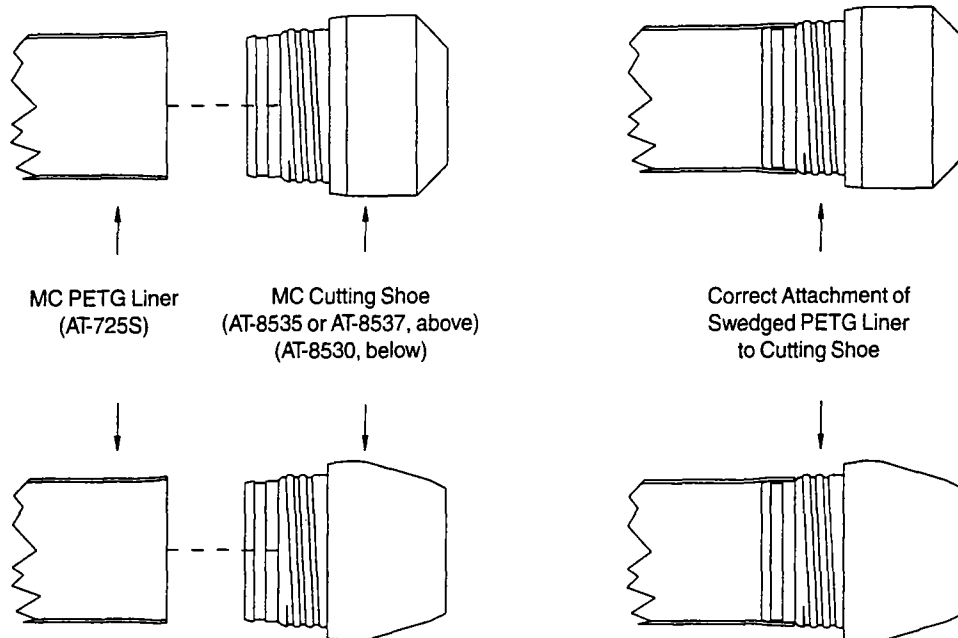


FIGURE 4.2
Macro-Core® PETG Liner Attachment

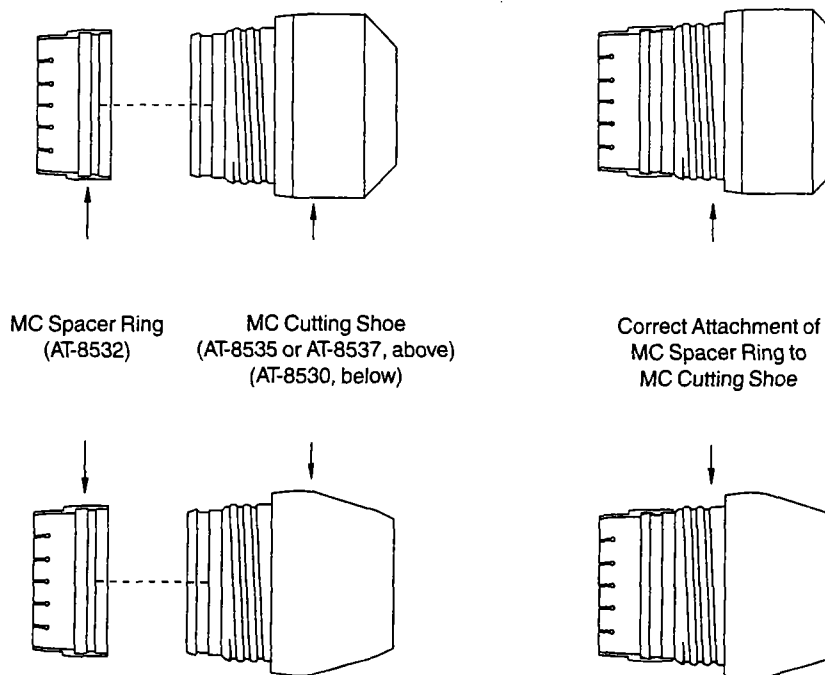
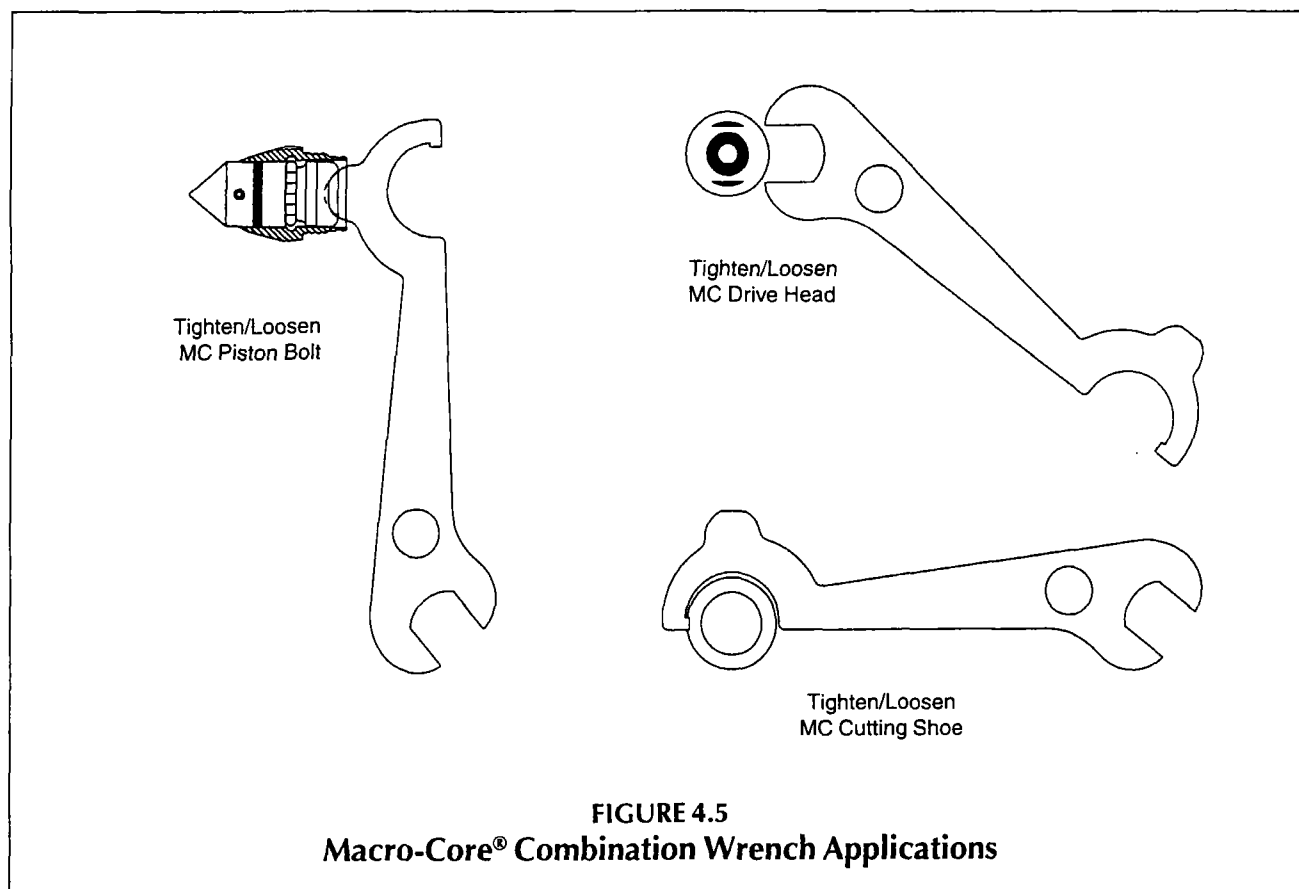
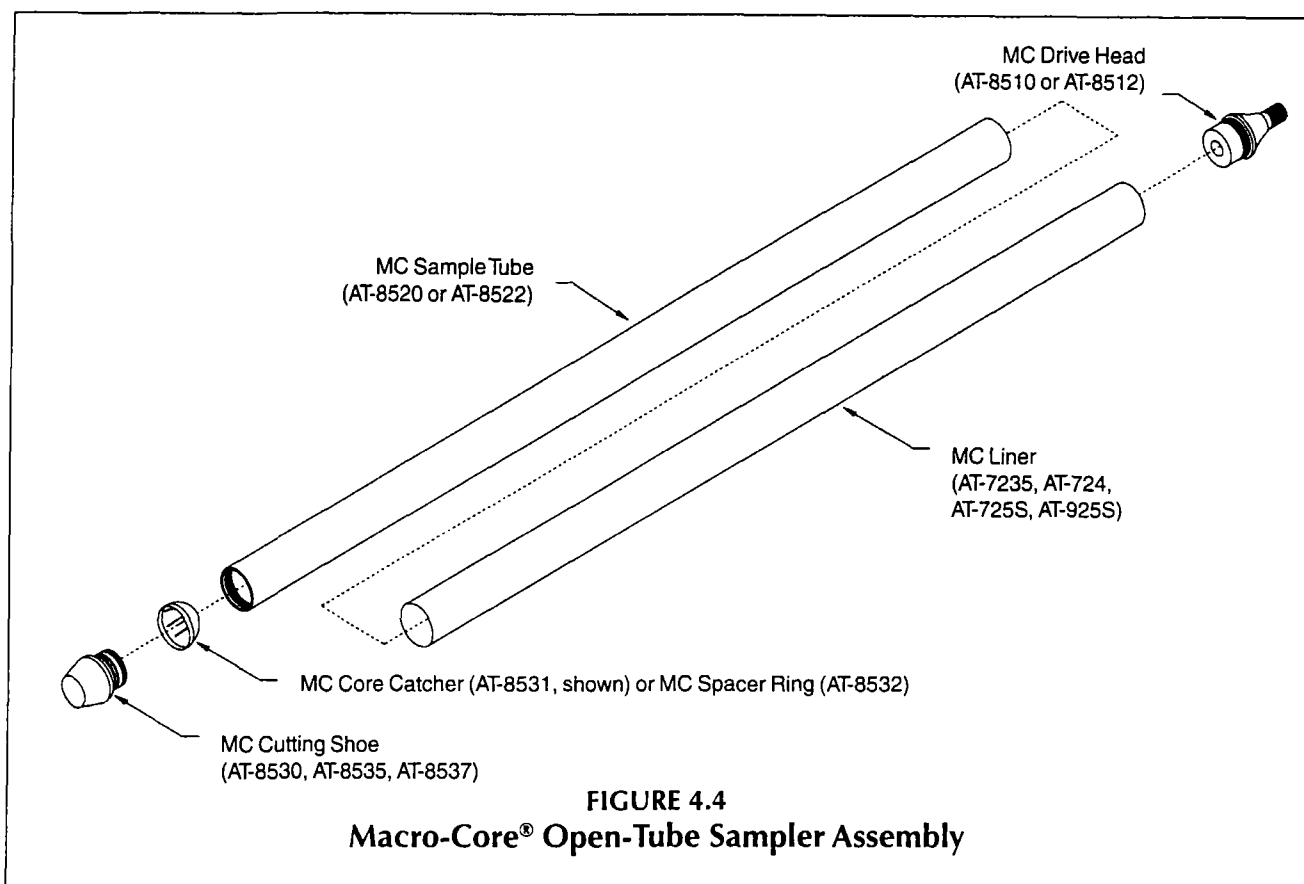


FIGURE 4.3
Macro-Core® Spacer Ring Attachment

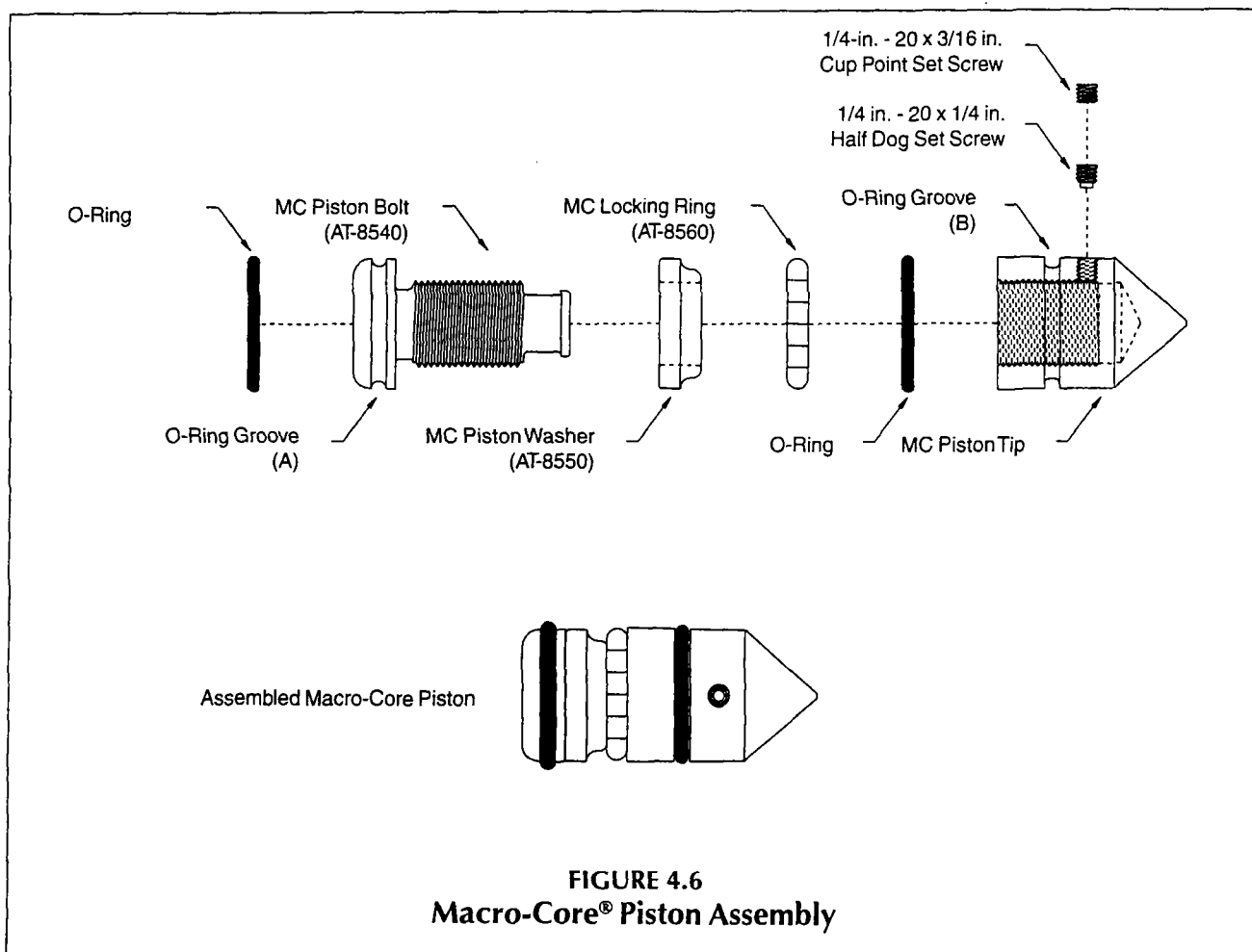


4.4 Closed-Piston Sampler Assembly (Fig. 4.6)

1. Install an O-ring in the machined groove on the piston bolt head (A) and piston tip (B).
2. Place a piston washer on a piston bolt with the radius side away from bolt head.
3. Position a locking ring on the piston bolt and thread the bolt into the piston tip.

NOTE: Piston bolt and tip are left-hand threaded.

4. Screw the piston bolt down tight and install a 1/4-inch - 20 x 1/4-inch half dog set screw in the hole on the side of the piston tip. With a 1/8-inch allen wrench, tighten the set screw until it contacts the stem of the piston bolt, then back it out one-quarter turn.
5. Back the piston bolt out until set screw hits the bottom shoulder on the bolt (approximately four full turns). The bolt must be tight against the set screw to prohibit the set screw from turning while completing Step 6.
6. Lock the half-dog set screw into place by installing a 1/4-inch - 20 x 3/16-inch cup point set screw in the same hole. The cup point set screw should be tight but the bolt should remain free to turn approximately four full turns.



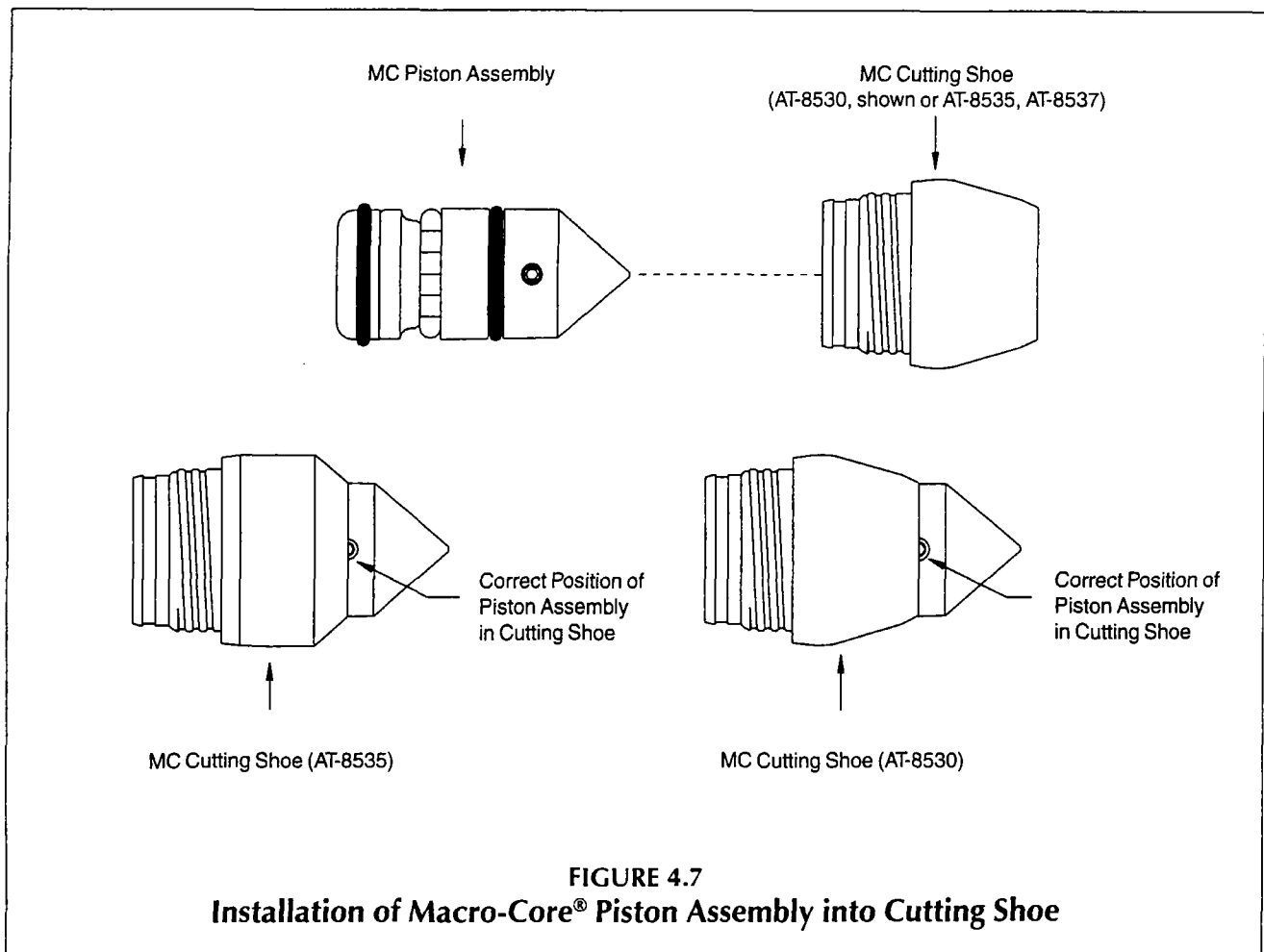
NOTE: The top of the cup point set screw must not protrude from the piston tip. File or grind the set screw flush with the side of the tip if necessary. The piston assembly is ready to install in the cutting shoe.

7. Slide an assembled piston into a cutting shoe. The piston should be placed so that one half of the set screw (located on the side of the tip) protrudes from under the edge of the cutting shoe (Fig. 4.7).
8. Tighten the piston bolt (left-hand threads) using the combination wrench (Fig 4.8).
- 9a. **With MC Core Catcher.** Place the open end of a core catcher over the threaded end of a cutting shoe (Fig. 4.9). Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

NOTE: AT-725S (PETG) liners have a swaged end which is generally slipped directly over the groove in the cutting shoe (Fig. 4.10). To use a core catcher with these liners, simply cut approximately 0.4 inches (10 mm) of material from the swaged end of the liner and continue to Step 10.



Figure 4.8. Using MC Combination Wrench to tighten MC Piston Bolt inside MC Cutting Shoe.



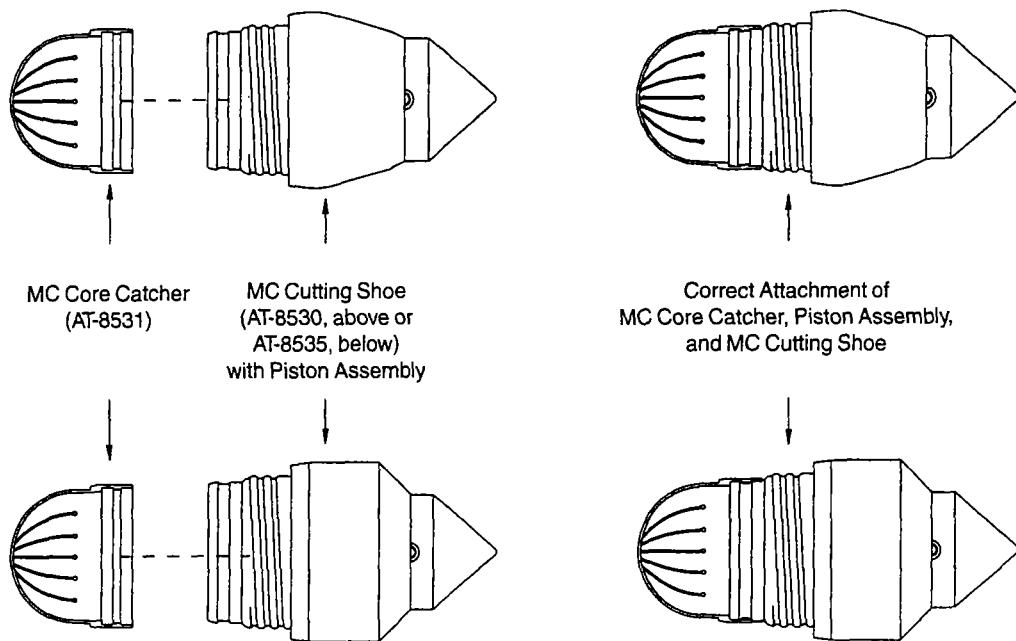


FIGURE 4.9
Macro-Core® Core Catcher Attachment with Piston Assembly

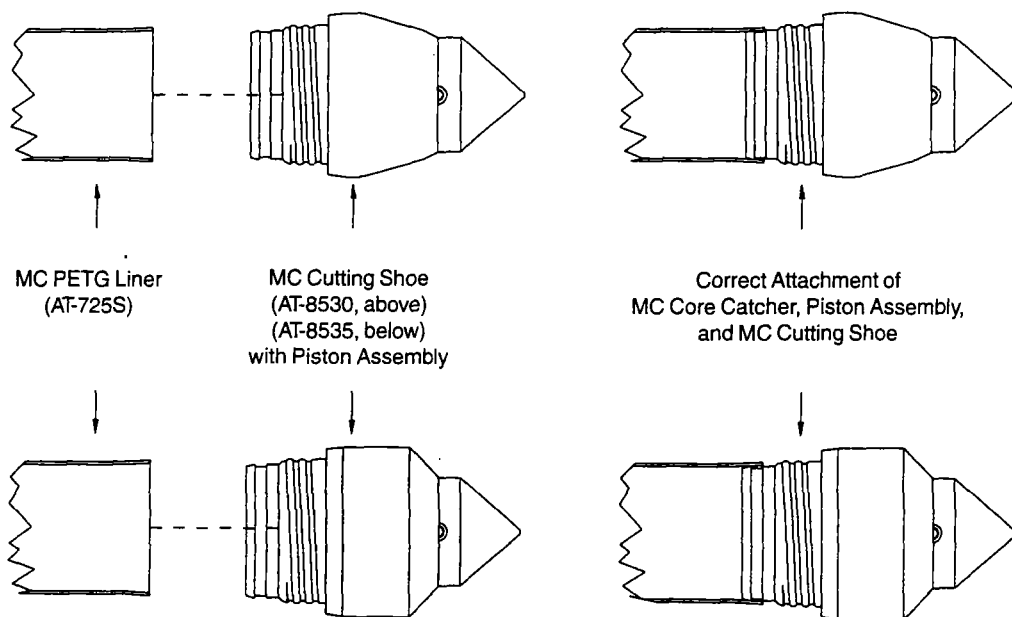


FIGURE 4.10
Macro-Core® PETG Liner Attachment with Piston Assembly

- 9b. Without Core Catcher.** Push the base of an MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place (Fig. 4.11).

NOTE: With the exception of AT-725S (PETG) liners, all liners must utilize either a spacer ring or core catcher. PETG liners have a swaged end which slides directly over the end of the cutting shoe. When using PETG liners, attach the liner to the cutting shoe (Fig. 4.10) before proceeding to Step 10.

10. Thread the cutting shoe into one end of an MC Sample Tube (Fig. 4.12). Tighten until the end of the sample tube contacts the machined shoulder of the cutting shoe.
11. Insert the appropriate liner into the sample tube (Fig. 4.12). (The liner is all ready installed if using PETG liners without a core catcher.)
12. Connect a drive head to the top of the sample tube (Fig. 4.12) and securely tighten with the combination wrench (Fig. 4.5). The end of the sample tube must contact the machined shoulder of the drive head.

4.5 Pilot Hole

A pilot hole prevents excessive sampler wear in tough soils and saves time when a discrete soil core is desired. The pilot hole is created by driving a 2.0-, 2.5-, or 3.0-inch MC Pre-Probe (see page 6 for part numbers) to the top of the sampling interval. Soil surfaces containing gravel, asphalt, hard sands, or rubble should be pre-probed to reduce wear on the cutting shoe and to avoid damage to the sampler. To save time when collecting a discrete soil core, pre-probe to the sampling interval rather than coring to depth with the sampler.

4.6 Open-Tube Sampling

The Macro-Core Open-Tube Sampler is used to gather continuous soil cores from the surface to depths exceeding 30 feet. A representative soil sample is obtained by driving the sampler 48 inches (1219 mm) into undisturbed soil. Upon retrieving the sampler, the liner and soil core are removed. The sampler is then reassembled with a new liner and inserted back down the same hole to take the next soil core.

The Macro-Core Cutting Shoe is tapered to minimize the amount of soil scraped from the core walls when inserting the sampler back down an existing hole. In spite of this, non-cohesive soils will often collapse to the bottom of the hole. This slough material then enters the sampler as the next soil core is collected, resulting in a non-representative sample. A Closed-Piston Macro-Core Sampler is required under such conditions. Instructions for sampling with the Open-Tube Macro-Core Sampler follow.

1. Attach a drive cap to the drive head of an assembled Open-Tube Macro-Core Sampler (Section 4.3).
2. Install a hammer anvil and anvil retainer cap assembly. Raise the hammer latch while driving the Macro-Core Sampler to avoid contact with the drive head.
3. Raise the hammer assembly to its highest position by fully extending the probe cylinder. If working with a Model 4200, 4220, or 420U, raise the machine foot to allow sufficient room to position the sampler below the hammer.

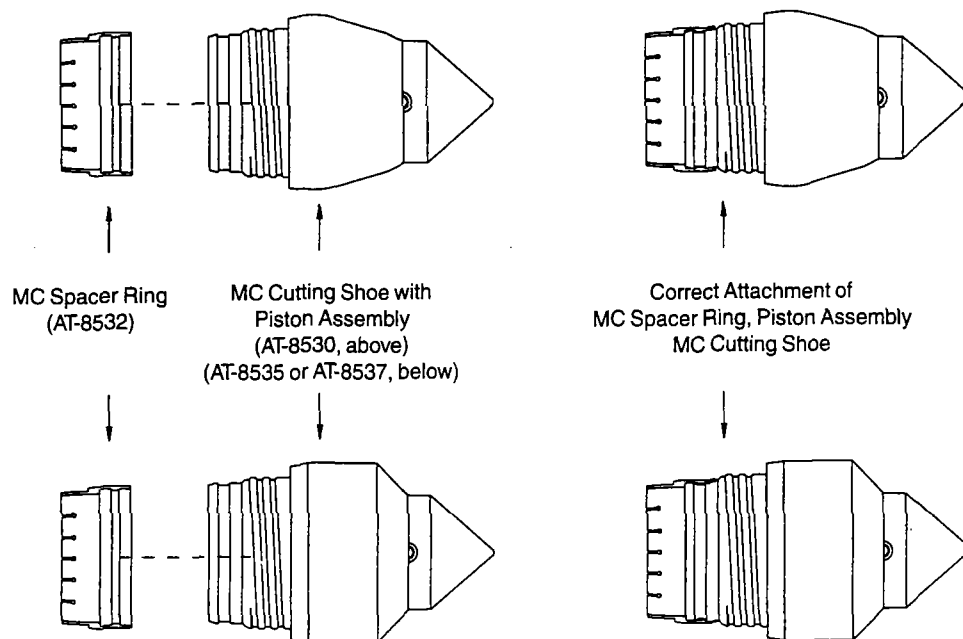


FIGURE 4.11
Macro-Core® Spacer Ring Attachment With Piston Assembly

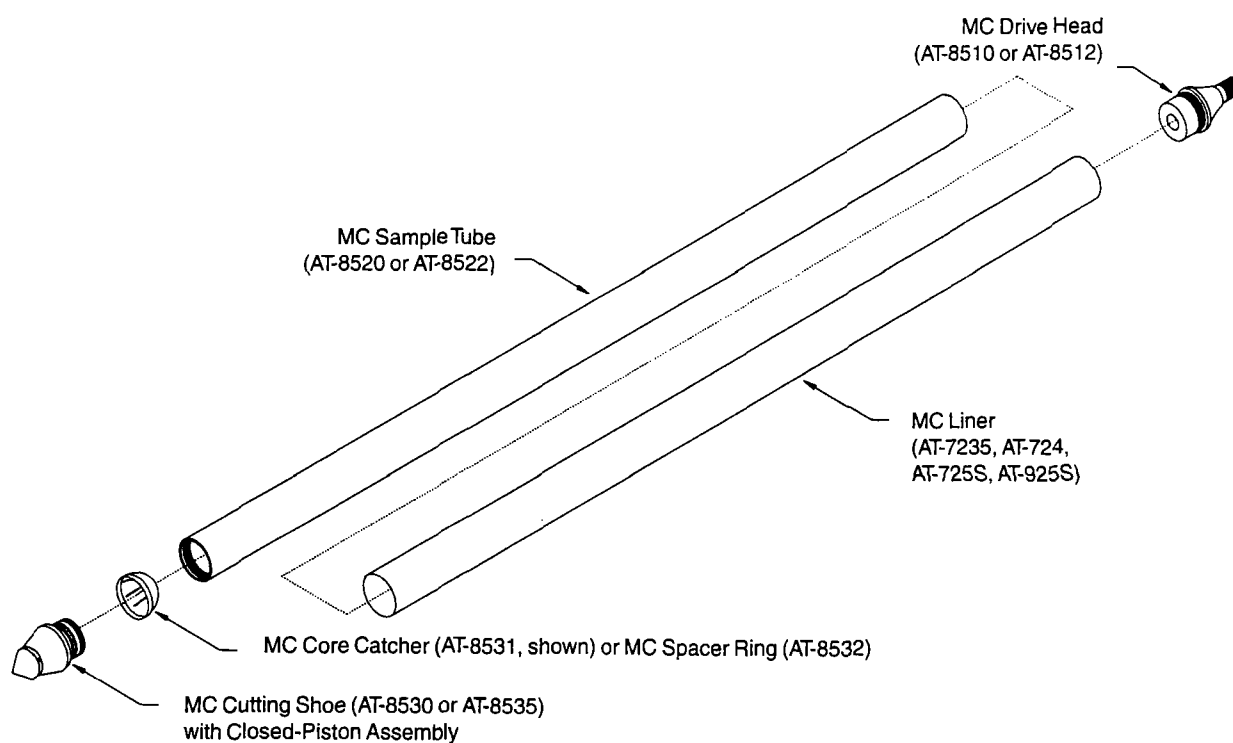
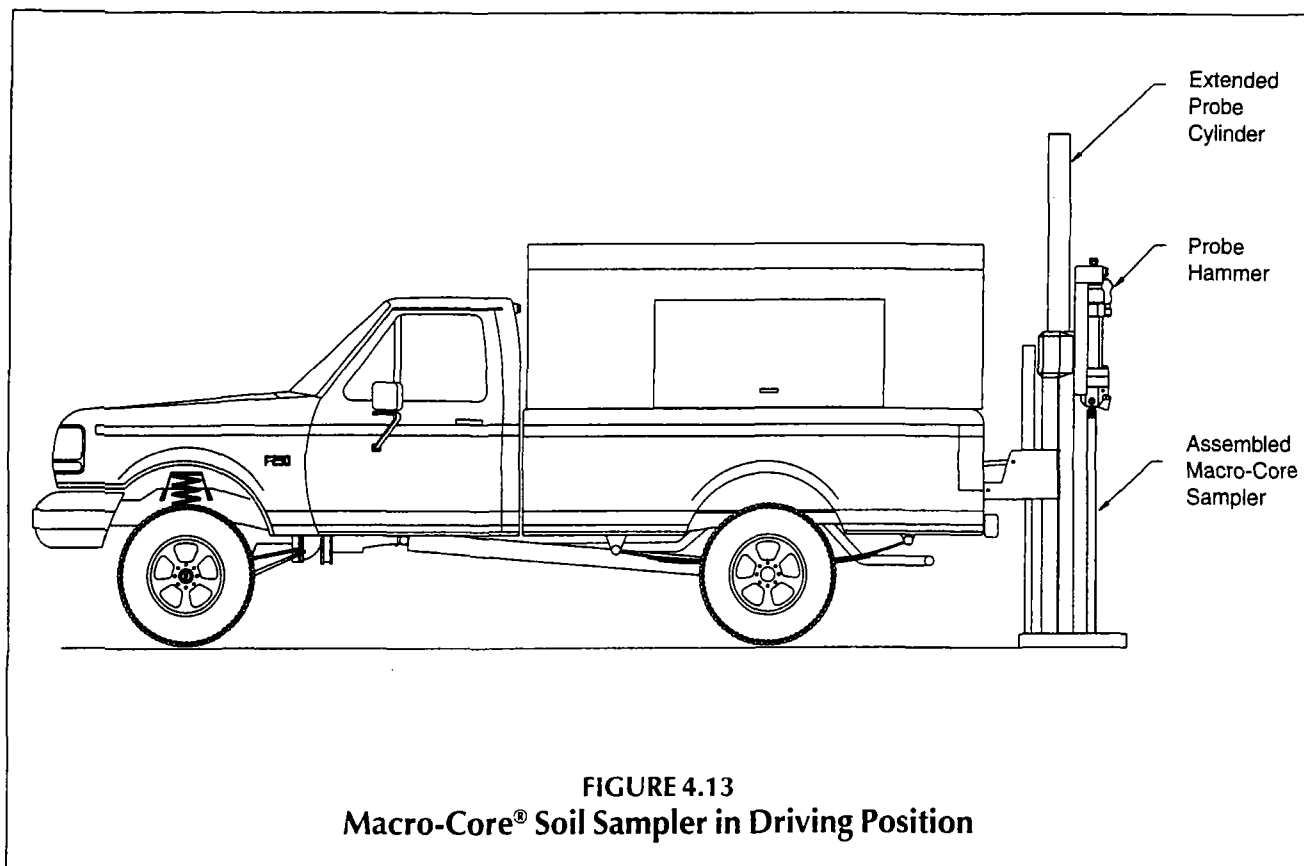


FIGURE 4.12
Macro-Core® Closed-Piston Sampler Assembly



4. Place the sampler in the driving position (Fig. 4.13). The sampler should always be positioned parallel to the derrick axis.
5. If using the Model 4200, 4220, or 420U, begin applying downward force on the sampler by lowering the machine foot. When the foot contacts the ground surface, apply downward force with the probe cylinder control only. Model 5400 and 540U operators may start initially with the probe cylinder control.

GEOPROBE TIP: **Activate the hammer whenever collecting soil. Hammering forces soil into the sample tube and increases recovery.**

6. Drive the sampler until the drive head reaches the ground surface (Fig. 4.14A).

*** CAUTION**

Some soil conditions may warrant using an MC Pre-Probe before attempting to collect a soil core. Damage may occur if the sampler is driven into rock or any other impenetrable layer.

7. To sample at consecutive intervals, push a sampler down the previously opened hole (Fig. 4.14B) until the top of the next sampling interval is reached (Fig. 4.14C). Drive the probe string another 48 inches to fill the sampler with soil (Fig. 4.14D). An open-tube sampler may be used for consecutive sampling or, if soil slough is expected, a closed-piston sampler is available.

*** CAUTION**

All parts must be completely threaded together before being driven. Driving an incompletely assembled sampler will result in component damage.

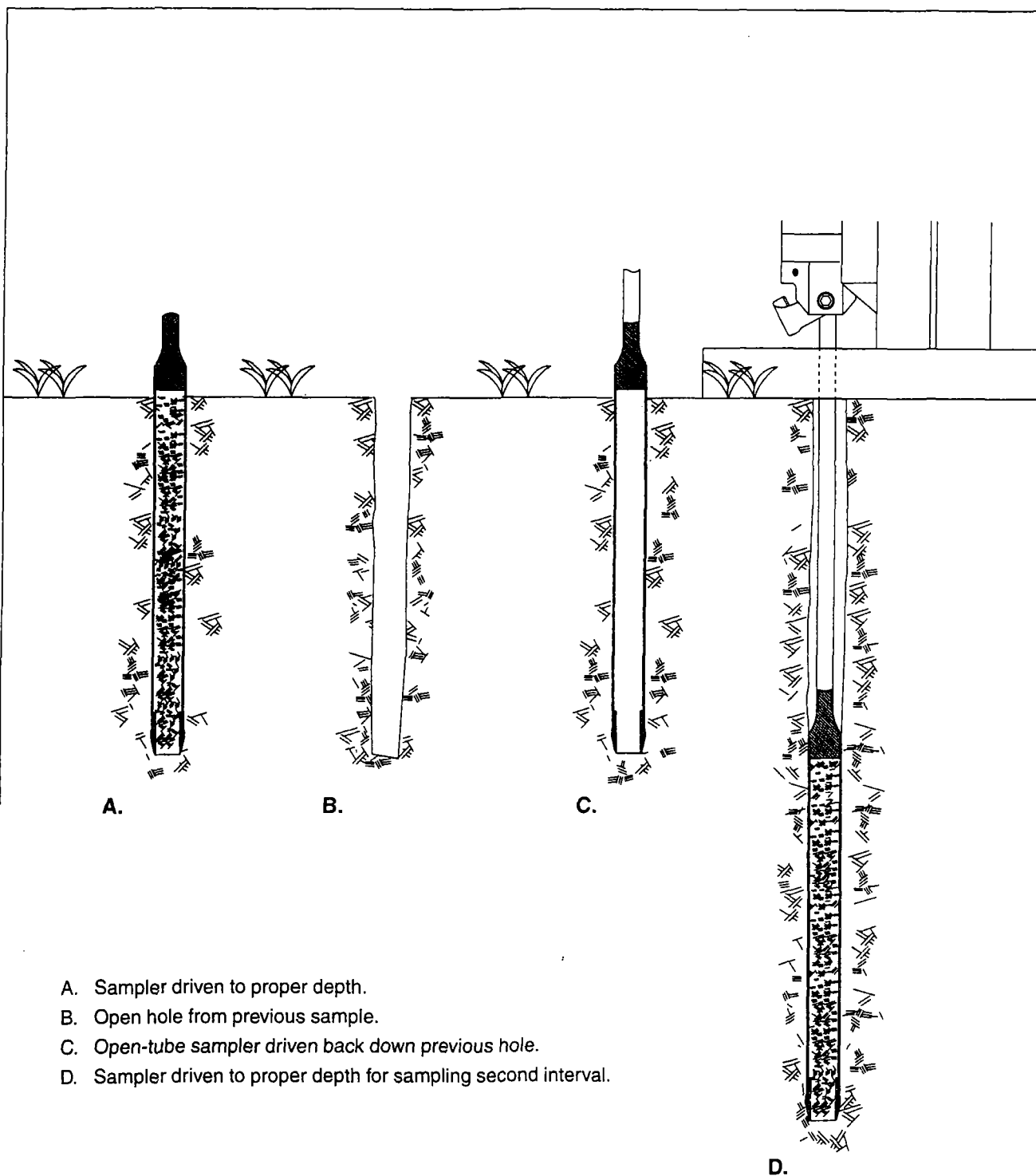
8. Retrieve the sampler as described in Section 4.8: Sampler Retrieval.

4.7 Closed-Piston Sampling

It is often difficult to collect representative soil cores from significant depths with an open-tube sampler due to soil slough. Because of this, the Macro-Core sampler can be equipped with a piston which locks into the cutting shoe. This allows the sealed sampler to pass through the slough material and be opened at the appropriate sampling interval.

NOTE: The closed piston system is meant to be inserted through previously opened holes. It is not designed to be driven from the surface through undisturbed materials.

The MC Closed-Piston System can be used only with AT-8500 series Macro-Core tools. The AT-8500 series replaces the AT-720 series Macro-Core tools.



- A. Sampler driven to proper depth.
- B. Open hole from previous sample.
- C. Open-tube sampler driven back down previous hole.
- D. Sampler driven to proper depth for sampling second interval.

FIGURE 4.14
Phases of Macro-Core® Open-Tube Soil Sampling

1. Attach a drive cap to the drive head of an assembled Closed-Piston Macro-Core Sampler (Section 4.4).
2. Install a hammer anvil and anvil retainer cap assembly. Raise the hammer latch while driving the sampler to avoid contact with the drive head.
3. Raise the hammer assembly to its highest position by fully extending the probe cylinder. If working with a Model 4200, 4220, or 420U, raise the machine foot to allow sufficient room to place the sampler below the hammer.
4. Place the sampler tip in the **previously opened hole** (Fig. 4.15A). Lower the probe until the hammer anvil contacts the sampler drive head.
5. If using the Model 4200, 4220, or 420U, begin applying downward force on the sampler by lowering the machine foot. When the foot contacts the ground surface, apply downward force with the probe cylinder control only. Model 5400 and 540U operators may start initially with the probe cylinder control.
6. Drive the sampler until it reaches the desired sampling interval (Fig. 4.15B). Add probe rods as needed.

*** CAUTION**

Care should be taken when driving the Macro-Core Sampler down a previously opened hole. Low side friction may allow the sampler and probe rods to drop down the hole. To prevent equipment loss, attach a pair of locking pliers or a pipe wrench to the rod string when advancing or retrieving the sampler.

7. Move the probe unit away from the top of the probe rods to allow room for work.
8. Remove the drive cap and insert an MC Piston Release Rod (Fig. 3.1) down the inside of the probe rods (Fig. 4.16). (Refer to Fig. 4.19 for identification of extension rod accessories.) Hold onto the release rod and attach an Extension Rod Coupler or Extension Rod Quick Links. Attach an Extension Rod to the release rod (Fig. 4.17) and lower the jointed rods down hole. Continue adding extensions until the release rod contacts the bottom of the sampler. The operator may opt to use the Extension Rod Jig to hold the down-hole extension rods while adding additional rods.
9. Attach an Extension Rod Handle to the top extension rod and slowly rotate the handle clockwise (Fig. 4.15C and 4.18). The release rod will drop into the groove in the piston bolt (Fig. 4.20). The operator should feel the extension rods move slightly as the release rod falls into the groove. Rotate the handle clockwise approximately four complete revolutions. Resistance to rotation is generally noted at this point. If the rods continue to rotate, however, do not continue for more than four complete revolutions. The piston assembly is now released and will be pushed to the top of the sampler as the liner is filled with soil (Fig. 4.15D).

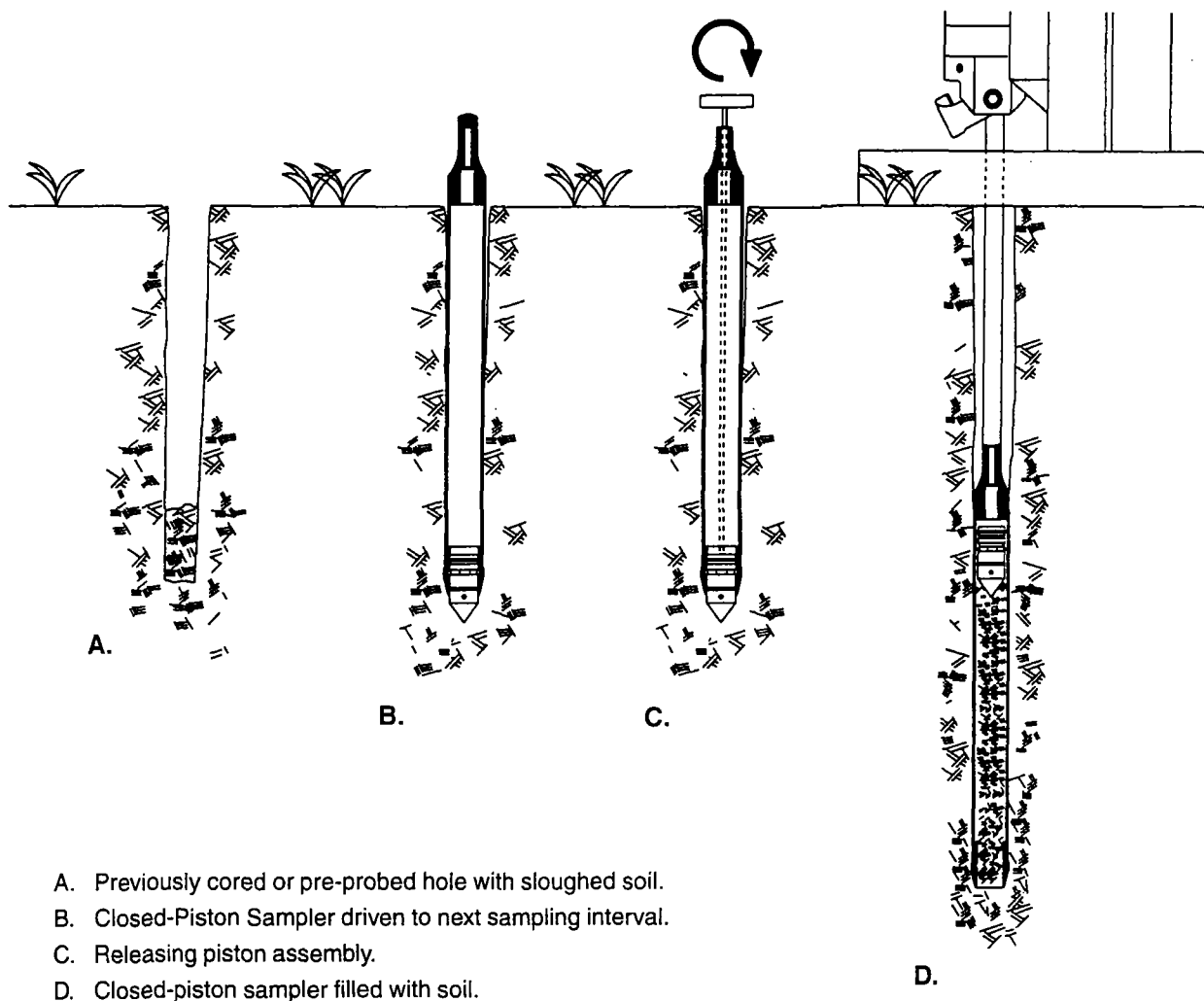


FIGURE 4.15
Phases of Macro-Core® Closed-Piston Soil Sampling

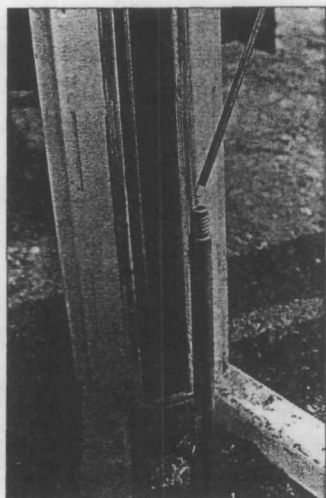


Figure 4.16. MC Release Rod is inserted down inside of the probe rods.

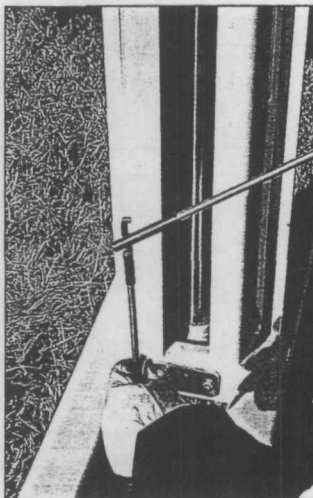


Figure 4.17. Extension Rods are attached to the MC Piston Release Rod using Extension Rod Quick Links.

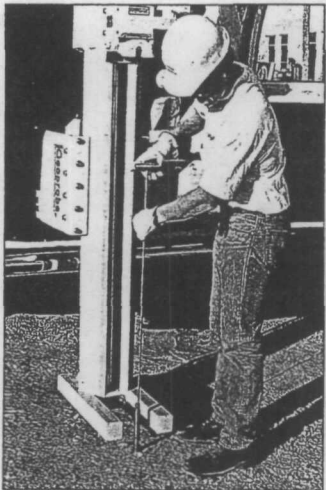


Figure 4.18. Extension Rods are rotated clockwise to release the MC Piston assembly.

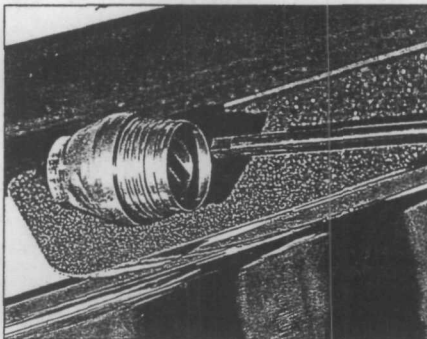


Figure 4.20. MC Release Rod fits into groove in MC Piston Bolt Head.

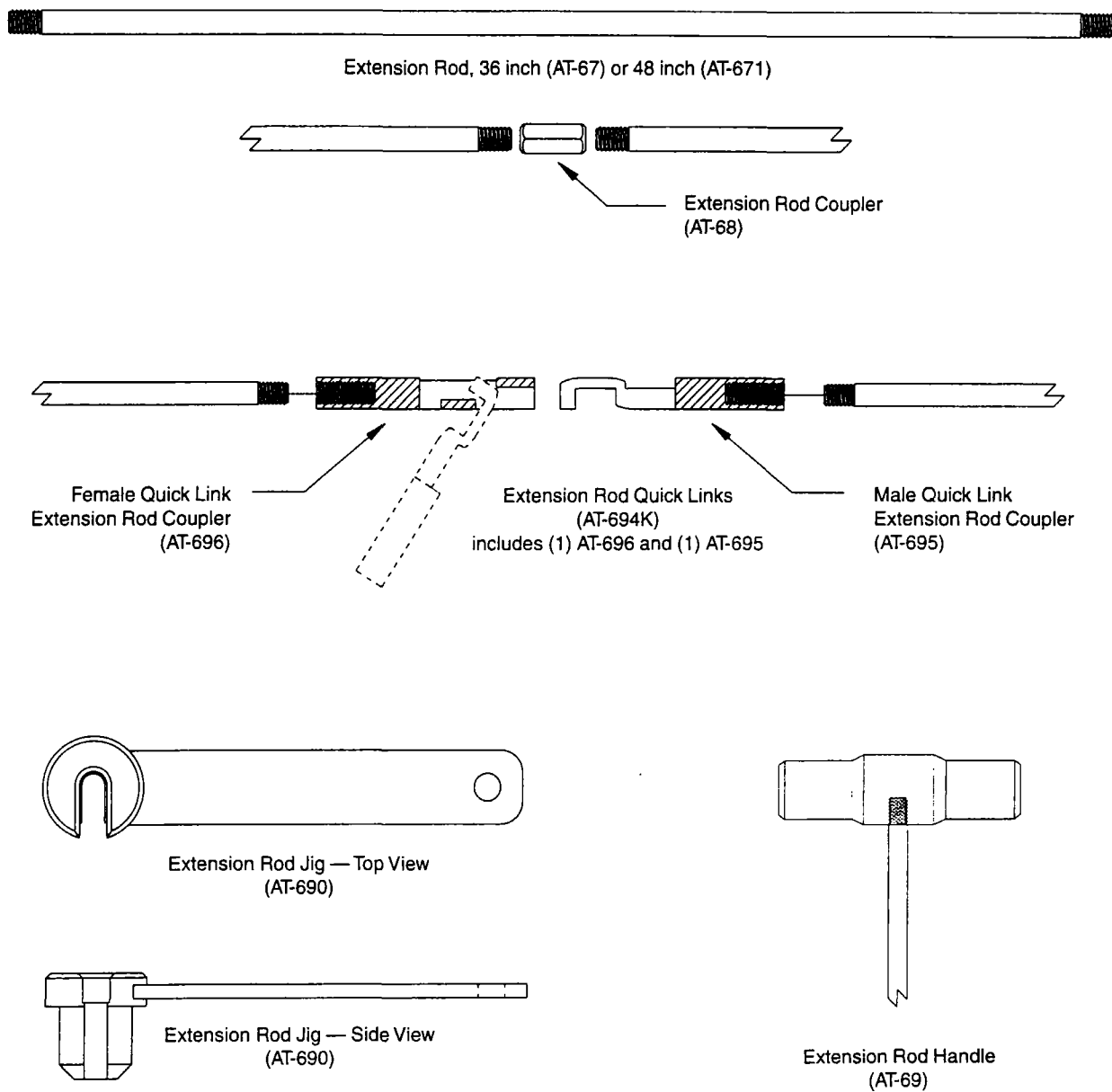


FIGURE 4.19
Geoprobe Extension Rods and Accessories

10. Remove the release rod and extension rods. The piston assembly will not be attached to the end of the extension rod but will remain inside the sampler tube.
11. Add a probe rod, attach the drive cap to the tool string, and reposition the probe unit. Drive the sampler another 48 inches (1219 mm) to fill the liner with soil. It will be necessary to add another probe rod if using 36-inch rods. Do not over-drive the sampler.

GEOPROBE TIP: **Activate the hammer whenever collecting soil. Hammering forces soil into the sampler tube and increases recovery.**

4.8 Sampler Retrieval

1. Attach a pull cap to the top probe rod. Close the hammer latch over the pull cap and pull the tool string up one rod length by actuating the PROBE control lever.
2. Remove the rod and repeat Step 1 until the sampler drive head is just above the ground surface. Probe rods are sometimes difficult to loosen by hand. Use pipe wrenches to free tight threads.

* CAUTION

**Care should be taken when retrieving the Macro-Core sampler.
Low side friction may allow the sampler and probe rods to drop down the hole.
Attach a pair of locking pliers or pipe wrench to the rod string to prevent equipment loss.**

3. Attach the pull cap to the sampler drive head (Fig. 4.21). Pull the sampler out of the ground (Fig. 4.22) by raising the PROBE control lever. If using a Model 4200, 420U, or 4220 Geoprobe unit, the probe cylinder will fully extend before the sampler is completely free. Attempt to raise the sampler by actuating the FOOT control.

* CAUTION

**The rear of the carrier vehicle may be pulled downward as the foot cylinder is activated if the sampler is lodged tightly in the ground.
Damage to the unit base frame may occur under such circumstances.**

If the sampler cannot be retrieved without excessive resistance, follow these steps:

1. Lower the FOOT control and disengage the hammer latch from the pull cap.
2. Raise the probe foot at least 12 inches (305 mm) above the ground surface. Stack several boards or place timber blocks under the foot to act as a foot extension.
3. Lower the hammer assembly and close the hammer latch over the sampler pull cap.
4. Use the PROBE control to lift the sampler completely out of the ground.

4.9 Soil Core Recovery

The soil sample is easily removed from the Macro-Core Sampler by unscrewing the cutting shoe and pulling out the liner. A few sharp taps on the cutting shoe will often loosen the threads sufficiently to allow removal by hand. If needed, the exterior of the cutting shoe features a notch for attaching the combination wrench to loosen tight threads (Fig. 4.23). With the cutting shoe removed (Fig. 4.24), simply pull the liner and soil core from the sample tube (Fig. 4.25).

If the closed-piston sampler is used, the piston assembly is now retrieved from the end of the liner (Fig. 4.26). Secure the soil sample by placing a vinyl end cap on each end of the liner.

Undisturbed soil samples can be obtained from Teflon®, PVC, and PETG liners by splitting the liner. Clamp one end of the liner to a board with locking pliers. Expose the soil core by making a longitudinal cut completely through the liner with a hook blade utility knife. A hook blade is recommended because it is not only easier to use, but it is also safer.

4.10 Macro-Core Closed-Piston Operating Tips

The Macro-Core piston assembly requires proper maintenance to ensure reliable operation. The following tips will increase the effectiveness of closed-piston sampling:

1. Cleanliness is the most important factor affecting piston operation. Ensure piston bolt threads and locking ring are free of soil particles and corrosion before each use. Completely thread and unthread the piston bolt to verify operation. Disassemble the piston tip and wash the individual parts using clean water and a nylon Macro-Core tube brush (BU-700) if necessary. Allow parts to dry before assembling if piston is to be stored. Disassemble used pistons before storing to prevent piston bolt corrosion.
2. Never store a cutting shoe with the piston installed. Install the piston assembly immediately before sampling.
3. Lubricate piston assembly with distilled water before installing in the cutting shoe.
4. Once the assembly is fully seated in the cutting shoe, tighten the piston bolt with an oscillating movement; thread the bolt in 90 degrees then back 45 degrees. When the end of thread travel is reached, work the last 30 degrees of travel back and forth several times. Tightening the piston bolt in this manner allows the metal pins of the locking ring to correctly align in the cutting shoe.
5. Do not lock the piston bolt 100 percent counterclockwise. Fully tighten the bolt and then loosen approximately 10 degrees.
6. When releasing the piston downhole, only turn the piston bolt 4 clockwise revolutions.
7. Clean the piston assembly with distilled water and a nylon Macro-Core tube brush between samples. It is not necessary to completely disassemble the piston at this time. Pay particular attention to the locking ring and ensure that all sand and grit is removed from between the metal lock pins.

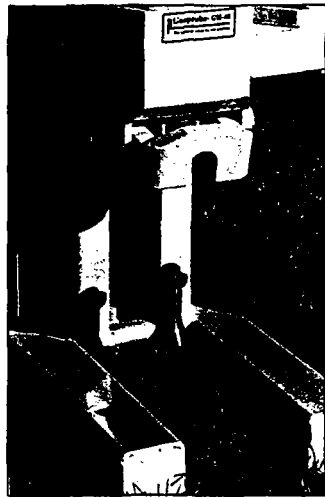


Figure 4.21. Pull Cap attached to MC Drive Head.



Figure 4.22. MC Soil Sampler is pulled with Geoprobe unit.



Figure 4.23. Loosening the MC Cutting Shoe with the MC Combination Wrench.



Figure 4.24. Removing MC Cutting Shoe and liner from MC Sampler Tube.

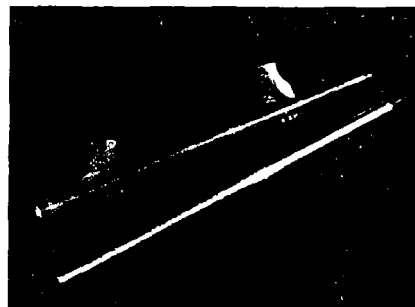


Figure 4.25. Macro-Core liner filled with soil core.

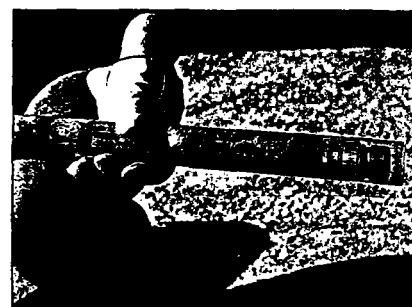


Figure 4.26. MC Piston assembly is retrieved from liner at the top of the soil core.

8. Locking rings are expensive but can be restrung on new springs. If a locking ring breaks, save the pieces for reuse. To restring a locking ring, follow these simple steps:
 - a. There is a small loop at each end of a new locking ring spring. Make sure one loop is bent perpendicular to the other. One loop should also be completely closed while the other is slightly open.
 - b. Attach a clamp as close to the open end as possible (without contacting the loop) to hold the spring. Fisherman fly-tying pliers work well for this procedure. Take care when attaching the clamp as the spring may be damaged if too much pressure is applied.
 - c. String 12 locking ring pins (macaroni-shaped metal pieces) on the closed end, stretching the spring as necessary. Be careful not to overstretch and damage the spring.
 - d. Hook the open end of the spring through the closed end and bend the loop closed.
 - e. Remove the clamp and gently stretch the locking ring several times to ensure that the loops will not open. Assembly is complete.
9. A locking ring groove is machined into the cutting shoe. Over time, the edges of this groove may begin to mushroom from use (Fig. 4.27). The raised metal lip formed by the mushroomed groove may cause the locking ring (and subsequently the piston) to bind in the cutting shoe. Remove the raised metal with a file or die grinder

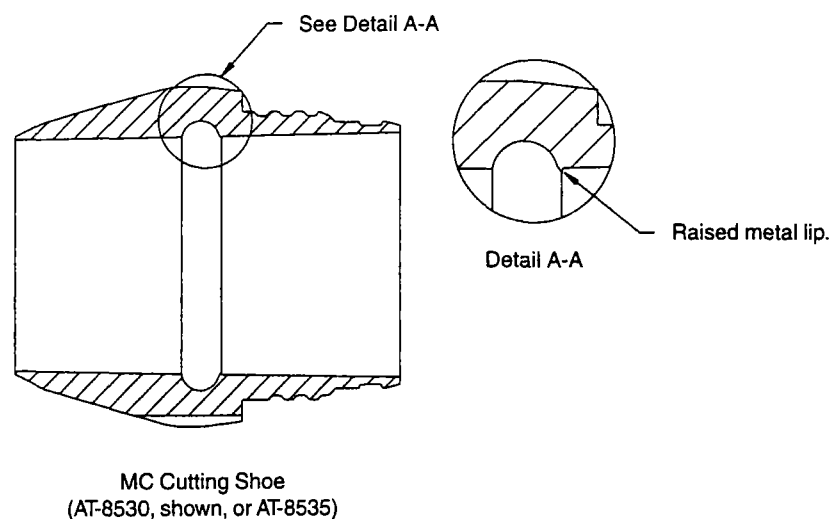


FIGURE 4.27
Macro-Core® Cutting Shoe with Mushroomed Locking Ring Groove

4.11 Tips to Maximize Sampling Productivity

The following suggestions are based on the collective experiences of Geoprobe operators:

1. Organize your truck or van to maximize efficiency. Assign storage areas to all tools and equipment for easy location. Store samplers, extension rods, and liners in racks. Above all, minimize the number of items lying loose in the back of the vehicle.
2. Take three or four samplers to the field. This allows the collection of several samples before stopping to clean and decontaminate the equipment. A system is sometimes used where one individual operates the probe while another marks the soil cores and decontaminates the used samplers.
3. A machine vise is a real plus. With the sampler held in a vise, the operator has both hands free to remove the cutting shoe (Fig. 4.28), drive head, and sample liner (Fig. 4.29). Cleanup is also easier with both hands free. Geoprobe offers an optional Machine Vise (FA-300) which mounts directly on the probe derrick (Fig. 4.30).
4. Extension Rod Quick Links (Fig. 4.31) are the best choice among connectors. These are real time savers. The quickest and easiest method for deploying extension rods is to assemble sections of up to three rods with threaded connectors. Each section is then connected with Quick Links. Up to three rods can be inserted or removed from the probe string at once, greatly reducing deployment time.
5. When releasing the piston assembly, insert extension rods in the probe string until the piston bolt is reached. Once the release rod falls into the groove in the bolt head, use a pair of locking pliers to turn the extension rods and release the piston. The locking pliers are quicker and easier than installing an extension rod handle.
6. It is most practical to use 48-inch probe rods when using the Macro-Core sampler. If using 36-inch probe rods, some rods must be partially driven in order to add up to the 48-inch sampler length. To maximize sampling efficiency, take 36-inch (914 mm) sample cores when 36-inch probe rods must be used.
7. Organize your worksite. The best way to maximize sampling efficiency is to practice with the sampler and identify a comfortable setup. Lay out all tools and equipment before probing. An example layout is shown in Figure 4.32.

A collapsible table or stand is handy to hold decontaminated sampler tubes and liners. Equipment may also be protected from contamination by placing it on a sheet of plastic on the ground.

Keep probe rods separate by identifying a location for "new" rods as well as a "put down pile." Initially drive the sampler with a new rod. As the rod is removed during sampler retrieval, place it in the put down pile for reuse. Drive the sampler to the top of the next sampling interval by using all of the rods in the put down pile. A new rod (located in a separate pile) is added and the string is driven to collect the next soil core. Once again, each probe rod is removed and placed in the put down pile as the sampler is retrieved. The cycle is repeated until all of the soil cores are recovered. This method eliminates the need to count rods while driving the sampler.

8. Cleanup is very important from the standpoint of operation as well as decontamination. Remove all dirt and grit from the threads of the drive head, cutting shoe, and sample tube with a nylon brush (BU-700). Without sufficient cleaning, the cutting shoe and drive head will not thread completely onto the sample tube. The threads may be damaged if the sampler is driven in this condition.

Ensure that all soil is removed from inside the sample tube. Sand particles are especially troublesome as they can bind liners in the sampler. Full liners are difficult to remove under such conditions. In extreme cases the soil sample must be removed from the liner before it can be freed from the sample tube.

9. The piston assembly may remain lodged in the cutting shoe when disassembling by hand, even though the piston bolt is completely loosened. This is because the locking ring and piston washer do not release from the groove in the cutting shoe as the piston bolt unthreads out of the tip. Hammering on the piston tip will have no effect because you are, in essence, forcing the tip tighter against the locking ring. To dislodge the piston, turn the assembly over and tap the top of the cutting shoe on a solid object. If the assembly still does not release, tap on the piston bolt with a hammer (taking care not to damage the release rod slot). This will jar the piston tip and bolt enough to release the locking ring from the groove in the cutting shoe.

*** CAUTION**

Do not push the piston assembly out of the cutting shoe by placing your hands on the piston tip. The cutting shoe is sharp and may cause injury when the assembly suddenly comes free. It is best to place the tip against a solid object, grasp the cutting shoe, and push the shoe over the assembly.

10. Although available for use with two sizes of probe rod, 1.25-inch O.D. rods are recommended for the Macro-Core Sampler. The larger rod diameter limits downhole deflection of the tool string and ultimately provides a more durable system. A new thread design also makes the 1.25-inch rods quicker and easier to thread together than previous 1-inch probe rods.
11. The Heavy-Duty Macro-Core Cutting Shoe (AT-8535) is machined with more material at the critical wear areas. It can be used in place of the standard cutting shoe (AT-8530) and is designed to lengthen service life under tough probing conditions.

Expansive clays and coarse sands can "grab" and collapse liners as the sample tube is filled with soil. A 1/8-inch undersized cutting shoe (AT-8537) will help alleviate this problem. The smaller diameter core (1.375 inches) allows expanding clays and coarse sands to travel up the sample liner without binding. The piston assembly can not be used with this cutting shoe.

12. Maximize the thread life of the sample tube by varying the ends in which the drive head and cutting shoe are installed. The dynamic forces developed while driving the sampler are such that the threads at the drive head wear more quickly than at the cutting shoe. Regularly switching ends will maintain relatively even wear on the sample tube.



Figure 4.28. Removing MC Cutting Shoe with filled sampler tube held in Machine Vise.



Figure 4.29. Removing filled liner with sampler tube held in Machine Vise.

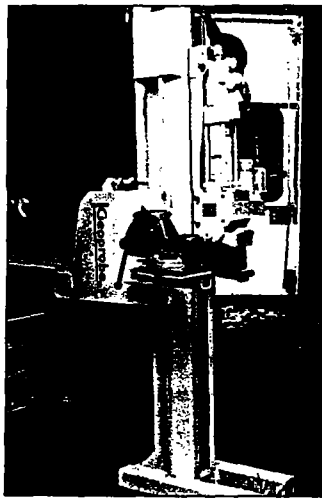


Figure 4.30. Machine Vise mounted directly on Geoprobe unit.



Figure 4.31. Using Extension Rod Quick Links to connect Extension Rods.

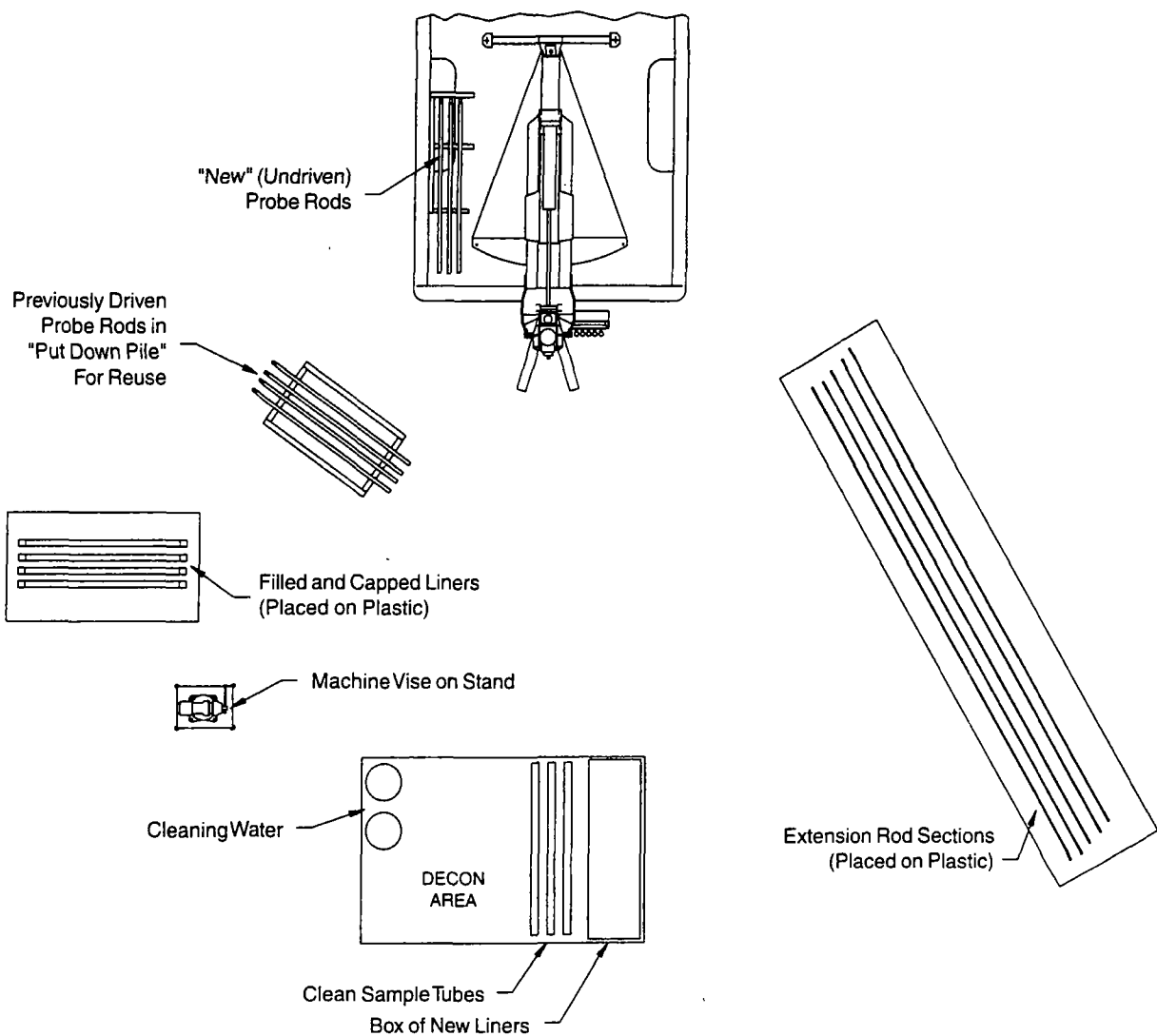


FIGURE 4.32
Equipment Layout Example to Maximize Sampling Productivity.

5.0 Macro-Core® Kits Listing

MACRO-CORE ACCESSORY KITS

AT-725K..... MC PETG Liners (Box of 66)
AT-726K..... MC Vinyl End Caps (66 Pairs)
AT-8513K..... MC Core Catchers (Box of 25)
AT-8532K..... MC Spacer Rings (Box of 25)
AT-8570R..... MC Piston O-Rings (Pkt. of 25)
AT-8561K..... MC Locking Ring Springs (Pkt. of 10)
AT-925K..... MC PVC Heavy-Duty Liners (Box of 66)

MACRO-CORE SAMPLER KITS

AT-8500K MC Starter Kit, Ni-Plated (fits 1-inch probe rods)

(1) AT-8501K ... MC Closed Piston Kit
(1) AT-8510 MC Drive Head
(1) AT-8520 MC Sample Tube, Ni-Plated
(1) AT-8530 MC Cutting Shoe
(1) AT-8580 MC Release Rod
(2) AT-8790 MC Combination Wrench
(2) BU-700 Nylon Brush for MC Tubes

AT-8514K MC Starter Kit, Ni-Plated (fits 1.25-inch probe rods)

(1) AT-8501K ... MC Closed Piston Kit
(1) AT-8512 MC Drive Head
(1) AT-8520 MC Sample Tube, Ni-Plated
(1) AT-8530 MC Cutting Shoe
(1) AT-8580 MC Release Rod
(2) AT-8590 MC Combination Wrench
(2) BU-700 Nylon Brush for MC Tubes

AT-8501K MC Closed-Piston Kit

(10) AT-8561K ... MC Locking Ring Springs
(1) AT-8530 MC Cutting Shoe
(1) AT-8540 MC Piston Bolt
(1) AT-8550 MC Piston Washer
(2) AT-8560 MC Locking Ring Assembly
(1) AT-8570 MC Piston Tip Assembly

AT-8502K MC Standard Sampler Kit, Ni-Plated (fits 1-inch probe rods)

- (1) AT-8510 MC Drive Head
- (1) AT-8520 MC Sample Tube, Ni-Plated
- (2) AT-8530 MC Cutting Shoe

AT-8512K MC Standard Sampler Kit, Ni-Plated (fits 1.25-inch probe rods)

- (1) AT-8512 MC Drive Head
- (1) AT-8520 MC Sample Tube, Ni-Plated
- (2) AT-8530 MC Cutting Shoe

AT-8503K MC Standard Sampler Kit, Unplated (fits 1-inch probe rods)

- (1) AT-8510 MC Drive Head
- (1) AT-8522 MC Sample Tube, Unplated
- (2) AT-8530 MC Cutting Shoe

AT-8511K MC Standard Sampler Kit, Unplated (fits 1.25-inch probe rods)

- (1) AT-8512 MC Drive Head
- (1) AT-8522 MC Sample Tube, Unplated
- (2) AT-8530 MC Cutting Shoe

AT-8506K MC Starter Kit, Unplated (fits 1-inch probe rods)

- (1) AT-8501K ... MC Closed Piston Kit
- (1) AT-8510 MC Drive Head
- (1) AT-8522 MC Sample Tube, Unplated
- (1) AT-8530 MC Cutting Shoe
- (1) AT-8580 MC Release Rod
- (2) AT-8590 MC Combination Wrench
- (2) BU-700 Nylon Brush for MC Tubes

AT-8513K MC Starter Kit, Unplated (fits 1.25-inch probe rods)

- (1) AT-8501K ... MC Closed Piston Kit
- (1) AT-8512 MC Drive Head
- (1) AT-8522 MC Sample Tube, Unplated
- (1) AT-8530 MC Cutting Shoe
- (1) AT-8580 MC Release Rod
- (2) AT-8590 MC Combination Wrench
- (2) BU-700 Nylon Brush for MC Tubes

APPENDIX A

COMPOUNDS DETECTABLE WITH THE MICROTIP™ TIP™ AND 10S™ SERIES OF PORTABLE GAS CHROMATOGRAPHS

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Acetaldehyde	10.21	GC/MicroTIP/TIP
Acetic Acid	10.37	MicroTIP/TIP
Acetone	9.69	GC/MicroTIP/TIP
Acetylene	11.41	GC/MicroTIP/TIP
Acetylene Dichloride	9.80	GC
Acetylene Tetrabromide	n.p.	MicroTIP/TIP
Acrolein	10.10	GC/MicroTIP/TIP
Acrylonitrile	10.91	GC/MicroTIP/TIP
Allene	9.83	GC/MicroTIP/TIP
Allyl Alcohol	9.67	GC/MicroTIP/TIP
Allyl Chloride	10.20	GC/MicroTIP/TIP
Aminoethanol	9.87	GC/MicroTIP/TIP
2-Amino Pyridine	8.34	MicroTIP/TIP
Ammonia	10.15	GC/MicroTIP/TIP
n-Amyl Acetate	n.p.	GC/MicroTIP/TIP
sec-Amyl Acetate	n.p.	GC/MicroTIP/TIP
Aniline	7.70	MicroTIP/TIP
Arsine	9.89	GC/MicroTIP/TIP
Benzaldehyde	9.53	GC/MicroTIP/TIP
Benzene	9.25	GC/MicroTIP/TIP
Benzenethiol	9.33	GC/MicroTIP/TIP
Bromobenzene	8.98	GC/MicroTIP/TIP
1-Bromobutane	10.13	GC/MicroTIP/TIP
2-Bromobutane	9.98	GC/MicroTIP/TIP
1-Bromobutanone	9.54	GC/MicroTIP/TIP
1-Bromo-2-chloroethane	10.63	GC/MicroTIP/TIP
Bromochloromethane	10.77	GC
Bromodichloromethane	n.p.	GC/MicroTIP/TIP
1-Bromo-3-chloropropane	n.p.	GC/MicroTIP/TIP
Bromoethane	10.28	GC/MicroTIP/TIP
Bromoethene	10.80	GC/MicroTIP/TIP
Bromoform	10.48	GC/MicroTIP/TIP
1-Bromo-3-hexanone	9.26	GC/MicroTIP/TIP
Bromomethane	10.53	GC/MicroTIP/TIP
Bromomethyl Ethyl Ether	10.08	GC/MicroTIP/TIP
1-Bromo-2-methylpropane	10.09	GC/MicroTIP/TIP
2-Bromo-2-methylpropane	9.89	GC/MicroTIP/TIP
1-Bromopentane	10.10	GC/MicroTIP/TIP
1-Bromopropane	10.18	GC/MicroTIP/TIP
2-Bromopropane	10.08	GC/MicroTIP/TIP
1-Bromopropene	9.30	GC/MicroTIP/TIP
2-Bromopropene	10.06	GC/MicroTIP/TIP
3-Bromopropene	9.70	GC/MicroTIP/TIP
2-Bromothiophene	8.63	GC/MicroTIP/TIP

APPENDIX A

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)-</u>	<u>ANALYZER</u>
o-Bromotoluene	8.79	GC/MicroTIP/TIP
m-Bromotoluene	8.81	GC/MicroTIP/TIP
p-Bromotoluene	8.67	GC/MicroTIP/TIP
1,3-Butadiene	9.07	GC/MicroTIP/TIP
2,3-Butadione	9.23	GC/MicroTIP/TIP
n-Butanal	9.83	GC/MicroTIP/TIP
2-Butanal	9.73	GC/MicroTIP/TIP
n-Butane	10.63	GC/MicroTIP/TIP
2-Butanone	9.53	GC/MicroTIP/TIP
iso-Butanol	10.47	GC/MicroTIP/TIP
sec-Butanol	10.23	GC/MicroTIP/TIP
tert-Butanol	10.25	GC/MicroTIP/TIP
1-Butene	9.58	GC/MicroTIP/TIP
cis-2-Butene	9.13	GC/MicroTIP/TIP
trans-2-Butene	9.13	GC/MicroTIP/TIP
n-Butyl Acetate	10.01	GC/MicroTIP/TIP
sec-Butyl Acetate	9.91	GC/MicroTIP/TIP
t-Butyl acetate	9.90	GC/MicroTIP/TIP
n-Butylalcohol	10.04	GC/MicroTIP/TIP
n-Butylamine	8.71	MicroTIP/TIP
i-Butylamine,	8.70	MicroTIP/TIP
s-Butylamine	8.70	MicroTIP/TIP
t-Butylamine	8.64	MicroTIP/TIP
n-Butylbenzene	8.69	GC/MicroTIP/TIP
i-Butylbenzene	8.68	GC/MicroTIP/TIP
t-Butylbenzene	8.68	GC/MicroTIP/TIP
Butyl Cellosolve®	8.68	GC/MicroTIP/TIP
i-Butyl Ethanoate	9.95	GC/MicroTIP/TIP
n-Butyl Mercaptan	9.15	GC/MicroTIP/TIP
t-Butyl Mercaptan	9.03	GC/MicroTIP/TIP
iso-Butyl Mercaptan	9.12	GC/MicroTIP/TIP
i-Butyl Methanoate	10.46	GC/MicroTIP/TIP
p-tert-Butyltoluene	8.35	GC/MicroTIP/TIP
1-Butyne	10.18	GC/MicroTIP/TIP
2-Butyne	9.85	GC/MicroTIP/TIP
n-Butyraldehyde	9.86	GC/MicroTIP/TIP
Carbon Disulfide	10.13	GC/MicroTIP/TIP
Carbon Tetrachloride *	11.28	GC/MicroTIP/TIP
Cellosolve Acetate	n.p.	GC/MicroTIP/TIP
Chloroacetaldehyde	10.16	GC/MicroTIP/TIP
Chlorobenzene	9.07	GC/MicroTIP/TIP
Chlorobromomethane	n.p.	GC
1-Chloro-2-bromoethane	10.63	GC/MicroTIP/TIP
1-Chlorobutane	10.67	GC/MicroTIP/TIP
2-Chlorobutane	10.65	GC/MicroTIP/TIP
1-Chlorobutanone	9.54	GC/MicroTIP/TIP
1-Chloro-2,3-epoxypropane	10.60	GC/MicroTIP/TIP
Chloroethane (Ethyl Chloride)	10.97	GC

APPENDIX A

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Chloroethene		GC/MicroTIP/TIP
2-Chloroethoxyethene	10.00	GC/MicroTIP/TIP
1-Chloro-2-fluorobenzene	10.61	GC/MicroTIP/TIP
1-Chloro-3-fluorobenzene	9.16	GC/MicroTIP/TIP
cis-1-Chloro-2-fluoroethene	9.21	GC/MicroTIP/TIP
trans-1-Chloro-2-fluoroethene	9.87	GC/MicroTIP/TIP
Chloroform *	9.87	GC/MicroTIP/TIP
o-Chloriodobenzene	11.37	GC/MicroTIP/TIP
Chloromethylethyl Ether	8.35	GC/MicroTIP/TIP
Chloromethylmethyl Ether	10.08	GC/MicroTIP/TIP
1 Chloro-2-methylpropane	10.25	GC/MicroTIP/TIP
Chlorobiprene	10.66	GC/MicroTIP/TIP
1-Chloropropane *	n.p.	GC/MicroTIP/TIP
2-Chloropropane *	10.82	GC/MicroTIP/TIP
3-Chloropropene	10.78	GC/MicroTIP/TIP
p-Chlorostyrene	10.04	GC/MicroTIP/TIP
2-Chlorothiophene	n. p.	GC/MicroTIP/TIP
o-Chlorotoluene	8.68	GC/MicroTIP/TIP
m-Chlorotoluene	8.83	GC/MicroTIP/TIP
p-Chlorotoluene	8.83	GC/MicroTIP/TIP
o-Cresol	8.70	MicroTIP/TIP
m-Cresol	8.48	MicroTIP/TIP
p-Cresol	8.48	MicroTIP/TIP
Cumene (i-Propyl Benzene)	8.48	GC/MicroTIP/TIP
Crotonaldehyde	8.75	GC/MicroTIP/TIP
Cyanoethene *	9.73	GC/MicroTIP/TIP
Cyanogen Bromide	10.91	GC/MicroTIP/TIP
3-Cyanopropene	10.91	GC/MicroTIP/TIP
Cyclobutane	10.39	GC/MicroTIP/TIP
Cyclohexane	10.50	GC/MicroTIP/TIP
Cyclohexanol	9.98	GC/MicroTIP/TIP
Cyclohexanone	10.00	GC/MicroTIP/TIP
Cyclohexene	9.14	GC/MicroTIP/TIP
Cyclo-octatetraene	8.95	GC/MicroTIP/TIP
Cyclopentadiene	7.99	GC/MicroTIP/TIP
Cyclopentane	8.55	GC/MicroTIP/TIP
Cyclopentanone	10.52	GC/MicroTIP/TIP
Cyclopentene	9.26	GC/MicroTIP/TIP
Cyclopropane	9.01	GC/MicroTIP/TIP
2-Decanone	10.06	GC/MicroTIP/TIP
Diacetone Alcohol	9.40	MicroTIP/TIP
1,3-Dibromobutane	n.p.	GC/MicroTIP/TIP
1,4-Dibromobutane	n.p.	GC/MicroTIP/TIP
Dibromochloromethane	n.p.	GC/MicroTIP/TIP
Dibromochloropropane	10.59	GC/MicroTIP/TIP
1,1-Dibromoethane	n.p.	GC/MicroTIP/TIP
Dibromomethane	10.19	GC/MicroTIP/TIP
	10.49	

APPENDIX A

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
1,2-Dibromopropane	10.26	GC/MicroTIP/TIP
2,2-Dibromopropane	n.p.	GC/MicroTIP/TIP
Dibutylamine	7.69	MicroTIP/TIP
1,2-Dichlorobenzene	9.07	GC/MicroTIP/TIP
1,3-Dichlorobutane *	n.p.	GC/MicroTIP/TIP
1,4-Dichlorobutane *	n.p.	GC/MicroTIP/TIP
cis-1,4-Dichloro-2-butene	n.p.	GC/MicroTIP/TIP
2,2-Dichlorobutane *	n.p.	GC/MicroTIP/TIP
2,3-Dichlorobutane *	n.p.	GC/MicroTIP/TIP
3,4-Dichlorobutene	n.p.	GC/MicroTIP/TIP
1,1-Dichloroethane *	11.06	GC/MicroTIP/TIP
1,2-Dichloroethane *	11.04	GC/MicroTIP/TIP
cis-Dichloroethene	9.65	GC/MicroTIP/TIP
trans-Dichloroethene	9.66	GC/MicroTIP/TIP
1,1-Dichloroethene	10.00	GC/MicroTIP/TIP
Dichloroethyl Ether	n.p.	GC/MicroTIP/TIP
Dichloromethane *	11.35	GC/MicroTIP/TIP
1,2-Dichloropropane *	10.87	GC/MicroTIP/TIP
1,3-Dichloropropane *	10.85	GC/MicroTIP/TIP
1,1-Dichloropropanone	9.71	GC/MicroTIP/TIP
2,3-Dichloropropene	9.82	GC/MicroTIP/TIP
Dicyclopentadiene	7.74	GC/MicroTIP/TIP
Diethoxymethane	9.70	GC/MicroTIP/TIP
Diethylamine	8.01	MicroTIP/TIP
Diethylamino Ethanol	8.58	MicroTIP/TIP
Diethyl Ether	9.53	GC/MicroTIP/TIP
Diethyl Ketone	9.32	GC/MicroTIP/TIP
Diethyl Sulfide	8.43	GC/MicroTIP/TIP
1,2-Difluorobenzene	9.31	GC/MicroTIP/TIP
1,4-Difluorobenzene	9.15	GC/MicroTIP/TIP
Di-4-bromodibromomethane	11.18	GC
Difluoromethylbenzene	9.45	GC/MicroTIP/TIP
1,1-Dimethoxyethane	9.65	GC/MicroTIP/TIP
Dimethoxymethane	10.00	GC/MicroTIP/TIP
Diiodomethane	9.34	GC/MicroTIP/TIP
Diisobutyl Ketone	9.04	GC/MicroTIP/TIP
Diisopropylamine	7.73	MicroTIP/TIP
Dimethylamine	8.24	MicroTIP/TIP
Dimethylaniline	7.13	MicroTIP/TIP
2,3-Dimethylbutadiene	8.72	GC/MicroTIP/TIP
2,2-Dimethylbutane	10.06	GC/MicroTIP/TIP
2,4-1-Dimethylbutan-3-one	9.18	GC/MicroTIP/TIP
2,3,3-Dimethylbutane	10.02	GC/MicroTIP/TIP
2,3-Dimethyl-2-butene	8.30	GC/MicroTIP/TIP
3,3-Dimethylbutanone	9.17	GC/MicroTIP/TIP
Dimethyl Disulfide	8.46	GC/MicroTIP/TIP
Dimethyl Ether	10.00	GC/MicroTIP/TIP
3,5-Dimethyl-4-heptanone	9.04	GC/MicroTIP/TIP
1,1-Dimethylhydrazine	8.88	MicroTIP/TIP

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<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
2,2-Dimethyl-3-pentanone	8.98	GC/MicroTIP/TIP
2,2-Dimethylpropane	10.35	GC/MicroTIP/TIP
Dimethyl Sulfide	8.69	GC/MicroTIP/TIP
Di-n-propyl Disulfide	8.27	GC/MicroTIP/TIP
Di-n-propyl Ether	9.27	GC/MicroTIP/TIP
Di-i-propyl Ether	9.20	MicroTIP/TIP
Di-n-propylamine	7.84	GC/MicroTIP/TIP
Di-n-propyl Sulfide	8.30	GC/MicroTIP/TIP
Epichlorohydrin	10.60	GC/MicroTIP/TIP
Ethane	11.65	GC/MicroTIP/TIP
Ethanol	10.62	MicroTIP/TIP
Ethanolamine	9.87	GC/MicroTIP/TIP
Ethanethiol (Ethyl Mercaptan)	9.29	GC/MicroTIP/TIP
Ethene (Ethylene)	10.52	GC/MicroTIP/TIP
Ethyl Acetate	10.11	GC/MicroTIP/TIP
Ethyl Acrylate	n. p.	GC/MicroTIP/TIP
Ethylamine	8.86	GC/MicroTIP/TIP
Ethyl Amyl Ketone	9.10	GC/MicroTIP/TIP
Ethylbenzene	8.76	GC/MicroTIP/TIP
Ethyl Bromide	10.29	GC/MicroTIP/TIP
Ethyl Butyl Ketone	9.02	GC/MicroTIP/TIP
Ethyl Chloroacetate	10.20	GC/MicroTIP/TIP
Ethyl Ethanoate	10.10	GC/MicroTIP/TIP
Ethyl Ether	9.41	GC/MicroTIP/TIP
Ethyl Disulfide	8.27	GC/MicroTIP/TIP
Ethylene Chlorohydrin	10.90	GC/MicroTIP/TIP
Ethylene Dibromide (EDB)	10.37	GC/MicroTIP/TIP
Ethylene Oxide	10.56	GC/MicroTIP/TIP
Ethyl Formate	10.61	GC/MicroTIP/TIP
Ethyl Iodide	9.33	GC/MicroTIP/TIP
Ethyl Methanoate	10.61	GC/MicroTIP/TIP
Ethyl Isothiocyanate	9.14	GC/MicroTIP/TIP
Ethyl Methyl Sulfide	8.55	GC/MicroTIP/TIP
Ethyl Propanoate	10.00	GC/MicroTIP/TIP
Ethyl Trichloroacetate	10.44	GC/MicroTIP/TIP
mono-Fluorobenzene	9.20	GC/MicroTIP/TIP
mono-Fluoroethene	10.37	GC/MicroTIP/TIP
mono-Fluoromethanal	11.40	GC/MicroTIP/TIP
Fluorotribromomethane	10.67	GC/MicroTIP/TIP
o-Fluorotoluene	8.92	GC/MicroTIP/TIP GC
m-Fluorotoluene	8.92	GC/MicroTIP/TIP
p-Fluorotoluene	8.79	GC
Formaldehyde	10.88	GC
Freon 11 (Fluorotrichloromethane)	11.77	GC
Freon 12 (Dichlorodifluoromethane)	12.91	GC
Freon 13 (Chlorotrifluoromethane)	12.91	GC
Freon 13 B-1 (Bromotrifluoromethane)	12.08	

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<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Freon 14 (Carbon Tetrafluoride)		GC
Freon 21 (Dichlorofluoromethane)	16.25	GC
Freon 22 (Chlorodifluoromethane)	12.00	GC
Freon 113 (1,2-Dichlorotrifluoroethane)	12.45	GC
Furan	11.78	GC/MicroTIP/TIP
Furfuryl Alcohol	8.89	GC/MicroTIP/TIP
Furfural	n.p.	GC/MicroTIP/TIP
n-Heptane	9.21	GC/MicroTIP/TIP
2-Heptanone	10.07	GC/MicroTIP/TIP
4-Heptanone	9.33	GC/MicroTIP/TIP
n-Hexane	9.12	GC/MicroTIP/TIP
Hexanone	10.18	GC/MicroTIP/TIP
2-Hexanone	n.p.	GC/MicroTIP/TIP
1-Hexene	9.44	GC/MicroTIP/TIP
sec-Hexyl Acetate	9.46	MicroTIP/TIP
Hydrazine	n. p.	GC/MicroTIP/TIP
Hydrogen Selenide	n.p.	GC/MicroTIP/TIP
Hydrogen Sulfide	9.88	GC/MicroTIP/TIP
Hydrogen Telluride	10.46	GC/MicroTIP/TIP
Iodobenzene	9.14	GC/MicroTIP/TIP
1-Iodobutane	8.73	GC/MicroTIP/TIP
2-Iodobutane	9.21	GC/MicroTIP/TIP
Iodoethane (Ethyl Iodide)	9.09	GC/MicroTIP/TIP
Iodomethane (Methyl Iodide)	9.33	GC/MicroTIP/TIP
1-Iodo-2-methylpropane	9.54	GC/MicroTIP/TIP
1-Iodo-2-methylpropane	9.18	GC/MicroTIP/TIP
.L-Iodopentane	9.02	GC/MicroTIP/TIP
1-Iodopropane	9.19	GC/MicroTIP/TIP
2-IodoproDane	9.26	GC/MicroTIP/TIP
O-Iodotoluene	9.17	MicroTIP/TIP
m-Iodotoluene	8.62	MicroTIP/TIP
p-Iodotoluene	8.61	MicroTIP/TIP
Isoamyl Acetate	8.50	GC/MicroTIP/TIP
Isoamyl Alcohol	9.90	GC/MicroTIP/TIP
isobutane	10-16	GC/MicroTIP/TIP
Isobutylamine	10.57	MicroTIP/TIP
Isobutyl Acetate	8.70	GC/MicroTIP/TIP
Isobutyl Alcohol	9.97	GC/MicroTIP/TIP
Isobutyl Formate	10.47	GC/MicroTIP/TIP
Isobutylene	10.46	GC/MicroTIP/TIP
Isobutyraldehyde	9.43	GC/MicroTIP-/TIP
Isopentane	9.74	GC/MicroTIP/TIP
Isoprene	10.32	GC/MicroTIP/TIP
Isopropyl Acetate	8.85	GC/MicroTIP/TIP
isopropyl Alcohol	9.99	GC/MicroTIP/TIP
isopropylamine	10-16	MicroTIP/TIP
-sopropylbenzene	8.72	GC/MicroTIP/TIP
	8.75	

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<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Isopropyl Ether	9.2,0	GC/MicroTIP/TIP
Isovaleraldehyde	9.71	GC/MicroTIP/TIP
Ketene	9.61	GC/MicroTIP/TIP
Mesitylene	8.40	GC/MicroTIP/TIP
Mesityl Oxide	9.08	GC/MicroTIP/TIP
Methanol k	10.85	GC
Methyl Acetate	10.27	GC/MicroTIP/TIP
Methyl Acrylate	10.72	GC
Methylamine	8.97	MicroTIP/TIP
Methyl Bromide	10-53	GC/MicroTIP/TIP
2-Methyl-1,3-butadiene	8.85	GC/MicroTIP/TIP
2-Methylbutanal	9.71	GC/MicroTIP/TIP
2-Methylbutane	10.31	GC/MicroTIP/TIP
2-Methyl-1-butene	9.12	GC/MicroTIP/TIP
3-Methyl-1-butene	9.51	GC/MicroTIP/TIP
3-Methyl-2-butene*	8.67	GC/MicroTIP/TIP
Methyl n-butyl Ketone	9.34	GC/MicroTIP/TIP
Methyl Butyrate	10.07	GC/MicroTIP/TIP
Methyl Cellosolve	n.p.	GC/MicroTIP/TIP
Methyl Cellosolve Acetate	n.p.	GC/MicroTIP/TIP
Methyl Chloroacetate	10.35	GC/MicroTIP/TIP
Methylchloroform	11.25	GC/MicroTIP/TIP
Methylcyclohexane	9.85	GC/MicroTIP/TIP
Methylcyclohexanol	9.80	GC/MicroTIP/TIP
Methylcyclohexanone	9.05	GC/MicroTIP/TIP
4-Methylcyclohexene	8.91	GC/MicroTIP/TIP
Methylcyclopropane	9.52	GC/MicroTIP/TIP
Methyl Dichloroacetate	10.44	GC/MicroTIP/TIP
Methyl Ethanoate	10.27	GC/MicroTIP/TIP
Methyl Ethyl Ketone	9.53	GC/MicroTIP/TIP
Methyl Ethyl Sulfide	8.55	GC/MicroTIP/TIP
2-Methyl Furan	8.39	GC/MicroTIP/TIP
Methyl Iodide	9.54	GC/MicroTIP/TIP
Methyl Isobutyl Ketone	9.30	GC/MicroTIP/TIP
Methyl Isobutyrate	9.98	GC/MicroTIP/TIP
Methyl Isocyanate	10.67	GC
1-Methyl-4-isopropylbenzene	n.p.	GC/MicroTIP/TIP
Methyl Isopropyl Ketone	9.32	GC/MicroTIP/TIP
Methyl Methacrylate	9.74	GC/MicroTIP/TIP
Methyl Methanoate	10.82	GC
Methyl Mercaptan	9.44	GC/MicroTIP/TIP
2-Methylpentane	10.12	GC/MicroTIP/TIP
3-Methylpentane	10-08	GC/MicroTIP/TIP
2-Methylpropane	10.56	GC/MicroTIP/TIP
2-Methylpropanal	9.74	GC/MicroTIP/TIP
2-Methyl-2-propanol	9.70	GC/MicroTIP/TIP
2-Methylpropene	9.23	GC/MicroTIP/TIP

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<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Methyl n-propyl Ketone	9.39	GC/MicroTIP/TIP
Methyl Styrene	8.35	GC/MicroTIP/TIP
Monomethyl Hydrazine	n.p *	GC/MicroTIP/TIF
Naphthalene	8.10	MicroTIP/TIP
Nitric Oxide	9.25	GC/MicroTIP/TIF
Nitrobenzene	9.92	MicroTIP/TIP
p-Nitrochlorobenzene	9.96	MicroTIP/TIP
n-Nonane	n.p.	GC/MicroTIP/TIP
5-Nonanone	9.10	GC/MicroTIP/TIP
n-Octane	n.p.	GC/MicroTIP/TIP
3-Octanone	9.19	GC/MicroTIP/TIP
4-Octanone	9.10	GC/MicroTIP/TIP
1-Octene	9.52	GC/MicroTIP/TIP
n-Pentane	10.53	GC/MicroTIP/TIP
cis-1,3-Pentadiene	8.59	GC/MicroTIP/TIP
trans-1,3-Pentadiene	8.56	GC/MicroTIP/TIP
n-Pentanal	9.82	GC/MicroTIP/TIP
2,4-Pentanedione	8.87	GC/MicroTIP/TIP
2-Pentanone	9.39	GC/MicroTIP/TIP
3-Pentanone	9.32	GC/MicroTIP/TIP
1-Pentene	9.50	GC/MicroTIP/TIP
Perfluoro-2-butene	11.25	GC
Perfluoro-1-heptene	10.48	GC/MicroTIP/TIP
n-Perfluoropropyl Iodide	10.36	MicroTIP/TIP
n-Perfluoropropyl-iodomethane	9.96	GC/MicroTIP/TIP
n-Perfluoropropyl-methyl Ketone	10.58	GC/MicroTIP/TIP
Phenol	8.69	MicroTIP/TIP
Phenyl Ether	8.09	GC/MicroTIP/TIP
Phenyl Isocyanate	8.77	GC/MicroTIP/TIP
Phosphine	9.96	GC/MicroTIP/TIP
Pinene	8.07	GC/MicroTIP/TIP
Propadiene	10.19	GC/MicroTIP/TIP
n-Propanal	9.95	GC/MicroTIP/TIP
Propane *	11.07	GC/MicroTIP/TIP
1-Propanethiol	9.20	GC/MicroTIP/TIP
n-Propanol	10.51	GC/MicroTIP/TIP
Propanone	9.69	GC/MicroTIP/TIP
Propene	9.73	GC/MicroTIP/TIP
Prop-1-ene-2-ol	8.20	GC/MicroTIP/TIP
Prop-2-ene-1-ol	9.67	GC/MicroTIP/TIP
Propionaldehyde	9.98	GC/MicroTIP/TIP
n-Propyl Acetate	10.04	GC/MicroTIP/TIP
n-Propyl Alcohol	10.20	GC/MicroTIP/TIP
n-Propylamine	8.78	MicroTIP/TIP
n-Propylbenzene	8.72	GC/MicroTIP/TIP
Propylene	9.73	GC/MicroTIP/TIP
Propylene Dichloride	n.p.	GC/MicroTIP/TIP
Propylene Imine	8.76	MicroTIP/TIP

APPENDIX A

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
Propylene Oxide	10.22	GC/MicroTIP/TIP
n-Propyl Ether	9.27	GC/MicroTIP/TIP
n-Propyl Formate	10.54	GC/MicroTIP/TIP
Propyne	10.36	GC/MicroTIP/TIP
Pyridine	9.32	MicroTIP/TIP
Styrene	8.47	GC/MicroTIP/TIP
Tetrabromoethane	n.p.	GC/MicroTIP/TIP
Tetrachloroethene (PCE)	9.32	GC/MicroTIP/TIP
1,1,1,,2-Tetrachloroethane	n.p.	GC/MicroTIP/TIP
1,1,2,2-Tetrachloroethane	n.p.	GC/MicroTIP/TIP
Tetrafluoroethene	10.12	GC/MicroTIP/TIP
Tetrahydrofuran	9.54	GC/MicroTIP/TIP
1,1,1,2-Tetrachloropropane	n.p.	GC/MicroTIP/TIP
1,2,2,3-Tetrachloropropane	n.p.	GC/MicroTIP/TIP
Thioethanol	9.29	GC/MicroTIP/TIP
Thiomethanol	9.44	GC/MicroTIP/TIP
Thiophene	8.86	GC/MicroTIP/TIP
1-Thiopropanol	9.20	GC/MicroTIP/TIP
Toluene	8.82	GC/MicroTIP/TIP
o-Toluidine	7.44	MicroTIP/TIP
Tribromoethene	9.27	GC/MicroTIP/TIP
1,1,1-Trichlorobutanone	9.54	GC/MicroTIP/TIP
1,1,1-Trichloroethane	11.25	GC/MicroTIP/TIP
1,1,2-Trichloroethane	n.p.	GC/MicroTIP/TIP
Trichloroethene (TCE)	9.45	GC/MicroTIP/TIP
Trichloromethyl Ethyl Ether	10.08	GC/MicroTIP/TIP
1,1,2-Trichloropropane	n.p.	GC/MicroTIP/TIP
1,2,3-Trichloropropane	n.p.	GC/MicroTIP/TIP
Triethylamine	7.50	MicroTIP/TIP
1,2,4-Trifluorobenzene	9.37	GC/MicroTIP/TIP
1,3,5-Trifluorobenzene	9.32	GC/MicroTIP/TIP
Trifluoroethene	10.14*	GC/MicroTIP/TIP
1,1,1-Trifluoro-2-iodoethane	10.10	GC/MicroTIP/TIP
Trifluoroiodomethane	10.40	GC/MicroTIP/TIP
Trifluoromethylbenzene	9.68	GC/MicroTIP/TIP
Trifluoromethylcyclohexane	10.46	GC/MicroTIP/TIP
1,1,1-Trifluoropropene	10.90	GC/MicroTIP/TIP
Trimethylamine	7.82	MicroTIP/TIP
2,2,4-Trimethyl Pentane	9.86	GC/MicroTIP/TIP
2,2,4-Trimethyl-3-pentanone	8.82	GC/MicroTIP/TIP
n-Valeraldehyde	9.82	GC/MicroTIP/TIP
'Vinyl Acetate	9.19	GC/MicroTIP/TIP
Vinyl Bromide	9.80	GC/MicroTIP/TIP
Vinyl Chloride	10.00	GC/MicroTIP/TIP
4-Vinylcyclohexene	8.93	GC/MicroTIP/TIP
Vinyl Ethanoate	9.19	GC/MicroTIP/TIP
Vinyl Fluoride	10.37	GC/MicroTIP/TIP
Vinyl Methyl Ether	8.93	GC/MicroTIP/TIP

APPENDIX A

<u>COMPOUND</u>	<u>IONIZATION POTENTIAL (eV)</u>	<u>ANALYZER</u>
o-Vinyl Toluene	8.20	MicroTIP/TIP
o-Xylene	8.56	GC/MicroTIP/TIP
m-Xylene	8.56	GC/MicroTIP/TIP
p-Xylene	8.45	GC/MicroTIP/TIP
2,4-Xylidine	7.65	MicroTIP/TIP

Notes

- * The sensitivity of the TIP, MicroTIP, and GC to these compounds may be enhanced by using an 11.7 eV lamp instead of the standard 10.6 eV lamp energy.

n.p. - Not published

Many compounds not appearing in this list, with an ionization potential of 12.0 eV or less, may also be detectable.

Ionization potentials for several other compounds can be found in Ionization Potential and Appearance Potential Measurements, 1971-1981, R.D. Levin and S.G. Lias, National Bureau of Standards, Washington, D.C., October 1982.

For further information, please contact the Technical Services/Applications Department at Photovac International Inc.

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APPENDIX B

Drilling and Well Installation

17.0 DRILLING AND WELL INSTALLATION

17.1 Introduction

This section provides guidelines for the installation of ground water monitoring wells (MW) for SI activities. Monitoring well installation will occur if:

- * The U.S. EPA Region V requests MW installation;
- * If Prescore indicates that MW installation may increase contaminant identification and therefore increase the HRS score.

17.1.1 Pre-Drilling Activities

This section is also included in the QAPjP as Pre-Sampling Activities. These activities include a review of all available historical site information, geographical information, geological and hydrogeological studies, and site characterization studies.

17.1.2 Site Safety Plan

This safety plan will include all health and safety (a.k.a., HASP) issues related to drilling activities that may occur on-site.

17.1.3 Site Reconnaissance

Prior to a SI, the Field Unit will survey the site to retrieve information that will determine locations for MW installation. These locations will be selected to ensure a complete ground water investigation.

Information collected during the reconnaissance should include at a minimum:

- * Bids for drilling subcontractor selection;
- * Landowner(s) permission to drill;
- * Evidence of disposal activities that may affect MW locations;
- * Vehicle access;

- * Special hazards (i.e., high power lines and buried utilities);
- * Terrain type (i.e., dense vegetation);
- * Well log information (if available).

17.2 Drilling Proposal

On approval of MW installation, a drilling proposal will be completed by a staff member with experience in the geotechnical field.

This proposal will include the following:

17.2.1 Introduction

- (1) Purpose for drilling and objectives;
- (2) Site location information with site map;
- (3) Number of proposed wells (see 17.2.4.1);
- (4) Preferred drilling technique (see 17.2.4.3), and;
- (5) Other pertinent information.

17.2.2 Background Information

- (1) Site history (from Section 2.3.1);
- (2) Waste characterization (from Section 2.3.1);
- (3) Sampling history/analytical results (from Section 2.3.1).

17.2.3 Site Characteristics

- (1) Site geography (from site reconnaissance)
 - (a) Terrain type,
 - (b) Vegetation type,
 - (c) Other pertinent features/hazards;
- (2) Site geology;

- (3) Site hydrogeology
 - (a) Surface water (e.g., surface water bodies and site drainage),
 - (b) Ground water (e.g., aquifer of concern with water usage, and aquifer characteristics);

17.2.4 Monitoring Well Installation

- (1) Total number and type of wells to be installed, well location map, and estimate of total well footage;
- (2) Mobilization information (i.e., terrain and vegetation from site reconnaissance), safety equipment, and possible problems;
- (3) Drilling method(s) (including QA/QC requirements;
- (4) Type and number of subsurface soil samples to be obtained includes bedrock coring;
- (5) Type and total footage of well materials (selection of well materials based on state requirements and/or "Procedures Manual for Ground Water Monitoring at Solid Facilities," U.S. EPA, 1977, "Ground Water and Wells," Johnson, 1975, or "Handbook for Sampling and Sample Preservation of Water and Wastewater," U.S. EPA, 1982);
- (6) Type, number, length, and slot size of well screens (see 17.2.4.6);
- (7) Well development techniques;
- (8) Information on containerization and disposal of potentially hazardous materials generated during MW installation (see Section 2.3.2);
- (9) Safety requirements and provisions.

17.3 Invitation for Bids/Drilling Subcontractor Selection

Invitation for Bids (IFB) will be prepared on approval of the drilling activity by U.S. EPA Region V SAM and the OEPA Site/Field Manager. This document will contain all background information and technical specifications necessary for a potential subcontractor to submit a competitive bid for the required geotechnical work. The information provided in the IFB should be readily transferrable from the drilling proposal.

A completed IFB and cover letter will be sent to several drilling firms selected from a list of potential bidders maintained by the OEPA. Dates for submittal of the bid packages and tentative commencement of drilling activities will be established by the OEPA.

Bid selection will be determined after careful review of the lowest bid. These bids will be evaluated based on the ability to comply with the technical specifications, time schedules, and U.S. EPA Region V policies stated in the drilling proposal. These contracts will be awarded by the U.S. EPA Region V, but will be managed by the OEPA.

17.4 Drilling Activities

These activities will include MW installation and aquifer tests for physical characterization.

17.4.1 Monitoring Well Drilling

The first day on-site the Field Unit and/or geotechnical staff will perform the following duties:

- * Remove excessive oil or hydraulic fluid from drilling rig(s);
- * Conduct a safety meeting for drillers;

- * Verify that drillers have appropriate safety equipment;
- * Inform drillers that petroleum-based lubricants on external parts during drilling is prohibited, and;
- * Establish an area for drilling equipment decontamination.

Upgradient wells should be installed first unless conditions prohibit. The following duties should be performed by a member of the drill rig team or Field Unit:

- * Monitor bore hole and cuttings with appropriate air monitoring instrument(s) to evaluate personnel safety (refer to the HASP for action levels);
- * Evaluate subcontractor's performance for adherence to established procedures outlined in the contract;
- * Monitor contractor's time and well footage log for all subcontract pay items (review daily);
- * Maintain boring logbook and classify drilling cuttings as to the physical properties outlined in "Guidelines for Classifying and Describing Soil and Rock Samples," U.S. EPA;
- * Collect environmental samples for chemical analysis, and;
- * Provide technical assistance to driller(s) during all phases of the investigation.

17.4.2 Measurements and Characteristic Tests for Aquifers

A hydrogeological study includes physical measurements and aquifer tests for physical characteristics. The following list must be completed:

- * Plot well locations on an appropriate scale map;
- * Survey well elevations;
- * Obtain water level measurements, and;
- * Conduct aquifer hydraulic conductivity.

17.4.2.1 Well Locations

Potential MW locations will be identified on maps for development of geologic cross-sections, preparation of potentiometric surface maps, and determination of horizontal hydraulic gradients.

The accuracy of these maps will be accomplished using the following:

- * Location on aerial photograph;
- * Field measurements with cloth tape from landmarks identified on an aerial photograph;
- * Surveying (see 17.4.4).

17.4.2.2 Well Surveying

Well surveying will include measurement of the ground and top of an inner well casing. The requirements for these measurements are provided below.

- Excellent leveling for United States Geological Surveying (U.S.G.S.) bench marks. These

bench marks are established by U.S.G.S. at known altitudes above sea level. Bench marks should be chosen on the U.S.G.S. Quadrangle Map at nearest five, ten, or twenty foot contour interval.

- Rod readings should be to the nearest thousandths of a foot either the target rod or the self-reading rod.

- Backsight and foresight distances measured by pacing and approximately balanced between bench marks.

- Rod waved for large rod readings.

- Carefully center bubble before each sight.

- Turning points on metal pin or plate, or on well-defined points of solid objects.

- Set tripod on firm ground.

- Maximum allowable error is +/- 0.05 miles.

- Surface water bodies should be included in the survey for comparison with ground water elevations.

17.4.2.3 Water Level Measurements

Accurate water level measurements are an integral part of all ground water studies. A minimum of one set of measurements is required although additional measurements taken through-out the year will provide a more complete picture of the ground

water system.

Ground water MW will be compared with nearby surface water elevations. Measurements of ground water and surface water elevations will be taken on the same day. Ground water and surface water elevations cannot be compared if they were determined on different days.

Water levels will be determined by evaluating the static water level and total well depth using OEPA FSOPs (see Appendix A).

17.4.2.4 Aquifer Hydraulic Conductivity

The hydraulic conductivity must be determined for the aquifer from the screened portion of all MW installed during OEPA activities. The OEPA and subcontractors will follow the procedures stated in "The Practical Guide for Ground Water Sampling," U.S. EPA, 1985.

water system.

Ground water MW will be compared with nearby surface water elevations. Measurements of ground water and surface water elevations will be taken on the same day. Ground water and surface water elevations cannot be compared if they were determined on different days.

Water levels will be determined by evaluating the static water level and total well depth using OEPA FSOPs (see Appendix A).

17.4.2.4 Aquifer Hydraulic Conductivity

The hydraulic conductivity must be determined for the aquifer from the screened portion of all MW installed during OEPA activities. The OEPA and subcontractors will follow the procedures stated in "The Practical Guide for Ground Water Sampling," U.S. EPA, 1985.

APPENDIX C

**CRL and CLP Sample Identification,
CLP Traffic Reports, SAS Traffic Reports, CRL COCs, Sample Tags,
Photographs, and Document Control and Confidentiality**

18.0 SAMPLE IDENTIFICATION AND CUSTODY FORMS

The OEPA will use the following sample numbering system for CLP and CRL analyses.

18.1 CLP Sample Identification

The U.S. EPA Region V will provide unique CLP sample numbers (e.g. labels) for samples submitted for RAS inorganic and organic analyses. Each sample will have an adhesive label with a unique CLP number per sampling location. These numbers will be documented in the field logbook along with the associated sampling information.

Example: Inorganic

MEPA01
|
MEPA 01
| |
└─┘ └─┘
Inorganic Sample location
Analyses

ME = Inorganic analyses

Organic

EPA01
|
EPA 01
| |
└─┘ └─┘
Organic Sample location
Analyses

E = Organic analyses

18.2 CRL Sample Identification

Samples submitted to the U.S. EPA CRL for analysis will have unique CRL numbers. These numbers will not be provided by U.S. EPA; however, the U.S. EPA has developed a numbering format. Each sample container will have an adhesive label with a unique CRL number per sampling location. These number will be documented in the field logbook along with the associated sampling information.

Example: 2000HS01S01

2000 = fiscal year
H = state code (i.e., OEPA)
S = sampler's initial
01 = sequential site number
(e.g., Baker site #1, Sims site #2)
S = sample type (e.g., s = investigative sample, d = duplicate, r = trip/field blank)

01 = sequential sample number per location

18.3 Sample Tags

Sample tags will be provided by the U.S. EPA Region V, these tags will be affixed to each sample container for CLP and CRL samples. These tags will be used by the U.S. EPA to track sample information (see Figure 2).

18.3.1 CLP Sample Tags

- * **Case Number**, this will be provided by the U.S. EPA once laboratory services have been arranged (e.g., 15324).
- * **Sample Number**, this will also be provided by the U.S. EPA (e.g., EPA01-adhesive labels).
- * **Month/Day/Year** the sample was collected.
- * **Time** the sample was collected.
- * **Comp or Grab**, the type of environmental sample.
- * **Station Number/Location**, identify the sample media (e.g., so = soil, se = sediment, rw = residential well, sw = surface water, mw = monitoring well etc...).
- * **Sampler Signature**, Field Investigators signatures.
- * **Preservatives** used in the sample.
- * **Analyses** requested for the sample.
- * **Remarks**, additional comments concerning the sample.
- * **MS/MSD** indicate if a sample requires a MS/MSD.

* **Lab Sample Number** leave blank.
(NOTE: Sample tags not required for Brownfield Assessments)

18.3.2 CRL Sample Tags

Sample tags will be completed for each sample container. These tags will be completed as the CLP tags except for the case number and sample number which will be different for these samples.

Example: CRL #: 93HS01S01

Case Number is the first 6 digits of the CRL number (i.e., 93HS01). The sample number is the remaining three digits of the CRL number (i.e., S01).

18.4 Traffic Reports

Traffic reports will be completed for all samples shipped for RAS or RAS/SAS analyses. Separate traffic reports will be completed for samples requested for inorganic and organic analyses. Examples of inorganic and organic traffic reports are provided in Figure 3 and Figure 4 respectively.

Components of an inorganic and organic traffic report are as follows:

- * **SAS No.**, this is provided only if special analytical services is requested.
- * **Case No.**, this is provided for all CLP analytical services.
- * **Project Code**, leave blank.
- * **Account Code**, leave blank.
- * **Region No.**, this is Region V.
- * **Sampling Co.**, this is OEPA.
- * **Date Shipped**, the date the samples were shipped.

- * **Carrier**, this is Federal Express or other carrier.
- * **Regional Information**, this is provided by the U.S. EPA, OEPA's is TFA102.
- * **Sampler's Name**, those individuals who collected the sample.
- * **Airbill Number**, this is the federal express tracking number provided on the bill and as adhesive labels.
- * **Preservative**, the associated number is place in column D for each sample.
- * **Sample Description**, the associated number is place in Column A for each sample.
- * **Non-Superfund Program** leave blank.
- * **Sampler Signature**, those individuals who collected the sample.
- * **Shipped To**, the address and the CLP Manager where samples were submitted for analysis.
- * **Site Name**, the name of the site being sampled.
- * **Site Address**, city and state.
- * **Site Spill ID**, if on the NPL enter the EPA site/spill code (two digits).
- * **Type of Activity**, these investigations are Federal lead sites, pre-remedial SSIs.
- * **CLP Sample Numbers**, numbers from the labels provided by U.S. EPA.
- * **Column A**, numbers from sample description (e.g., surface water and ground water, etc...).

- * **Column B**, suspected concentration of the samples (e.g., low, medium, and high).
- * **Column C**, sample type either grab or composite.
- * **Column D**, numbers from preservative (e.g., HCl, NaOH, ice, etc...).
- * **Column E**, type of RAS analyses requested per sample.
- * **Column F**, tag numbers provided on the bottom of each sample tag (i.e., U.S. EPA tracking numbers)/
- * **Column G**, station location number, location where sample was collected (e.g., SW-1).
- * **Column H**, month/day/year and time sample was collected.
- * **Column I**, sampler's initials.
- * **Column J**, corresponding CLP organic or inorganic sample number.
- * **Column K**, field QC qualifiers, use **B** for field blank, **D** for duplicate, -- for not a QC sample. Do not use **S** or **PE**.
- * **Shipment of Case complete?** state yes or no and identify the number of coolers to be shipped for that case (e.g., 1 of 2 coolers-case not complete, or 1 of 1 cooler-case complete).
- * **Page 1 of __** specify the number of traffic reports contained in a cooler.
- * **Sample used for spike** indicate the CLP sample number designated for a MS/MSD.
- * **Additional Sampler Signatures** leave blank.

- * **Chain-of-Custody Seal Number(s)** these seals (usually orange) are provided by the U.S. EPA and numbered to monitor samples during transit to ensure sample integrity.
- * **Relinquish signatures**, signatures of sampler(s) relinquishing custody of the samples.
- * **Split samples** document if the owner/operator requested split samples, if accepted have the owner/operator sign the document.

Container lot numbers will also be provided on each traffic report per container type (e.g., VOCs 40 ml, Semi-VOCs 1L amber etc...) and recorded in the associated site logbook.

Traffic reports must be submitted to U.S. EPA Region V within seven days from completion of the investigation. The paperwork is distributed as follows:

- * Yellow and white copies (for inorganic/organic) shipped with samples;
- * Blue copy (organic) and green copy (inorganic) will be sent to U.S. EPA RSCC;
- * Pink copies (inorganic/organic) will be sent to the U.S. EPA SMO;
- * Photocopies of the completed original traffic reports will be maintained in the OEPA DCC.

18.5 CRL Chain-of Custody Form

Routine COC forms will be used for samples shipped to the CRL for analysis. These forms will be completed as stated in the FSOPs except for the project/case number and station number (see Figure 5).

The project/case number is the first 6 digits of the CRL number, and the station/sample number is the last three digits of the CRL number as stated in section 15.3.2.

The following list is additional information that will be included on these forms:

- * Sample tag numbers;
- * Cooler 1 of ____;
- * Container lot numbers;
- * COC Seal numbers;
- * Airbill Number;
- * Laboratory name.

This paperwork must be submitted to U.S. EPA Region V within seven days from completion of the investigation. The distribution is as follows:

- * White copy - shipped with samples;
- * Pink copy - retained in OEPA DCC;
- * Yellow copy - returned to OEPA office and forwarded to CRL.

18.6 Special Analytical Service Traffic Report Form

The SAS Traffic Report Form is no longer utilized. A routine C-O-C form is the form that is utilized.

18.7 Photographs

Photographs are important in documenting the cause-and-effect relationship of hazardous materials migrating off-site, especially concerning the areas of environmental damage and potential human exposure.

Photographs will be taken during sample collection to verify written documentation in the field logbook. The following information will be written on the photograph:

- (1) Date, time, and location of the sample/subject;
- (2) Number of the photograph and/or film roll number;
- (3) Name of person taking the photograph.

Additional photographs will be taken of all coolers showing COC seals, labels, proper sample packaging, and ice (if applicable) prior to sample shipment. These photographs will be kept in the project files in the OEPA DCC.

18.8 Federal Express Airbill

All samples collected during a SI will be shipped to the laboratory by Federal Express.

The procedures to complete the airbill are as follows:

- (1) Block 1 - Shipper's name is the Field Investigator's name, agency, address, phone number;
- (2) Block 2 - Laboratory's name, address, phone number, and contact (i.e., CLP Manager);
- (3) Block 3 - Enter account number;
- (4) Block 4 - Services - Check #1, Overnight, Delivery - Check #2, Weekday or #3 if Saturday service is required.

The pink copy of the airbill will be retained by the OEPA and kept in the DCC.

19.0 DOCUMENT CONTROL AND CONFIDENTIALITY

19.1 Document Control

Results from investigations identifying hazardous substances on-site will be used to support litigation under the enforcement provision of the Resource Conservation and Recovery Act of 1976 (RCRA Public Law 94-580), and the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund, Public Law 96-510).

All information, analytical results, field data, samples, and documents must be treated as evidence and retrievable on completion of the project.

The document control elements are described in Chapter V-C of the NEIC "Enforcement Considerations for Evaluation of Uncontrolled Hazardous Waste Disposal Sites by Contractors," April 1984, revised in June 1985.

19.2 Project Files

On completion of an investigation, all information will be organized into a project file. This information will be needed as evidence in litigation, all information should be

inventoried and tracked to ensure document integrity.

A project file will include the SSWP, field logbooks, historical records, correspondence, report notes and calculations, photographs, maps, references, and final reports. A separate file will be maintained for sample documents, COCs, and analytical results.

19.3 Confidential Information

Information given to a Field Investigator and declared confidential will be treated as such. A justification for the confidentiality must be provided at the time of the claim. All confidential information will be identified and stored in the OEPA DCC. The U.S. EPA SAM will also identify confidential documents.

The OEPA will identify all draft SI reports, pertinent site information, and analytical results collected during a SI as confidential until a final report is approved by the U.S. EPA SAM (all HRS scoring results will remain confidential).

Sample Labeling and shipment:

U.S. EPA's Central Regional Laboratory (CRL):

Sample labels will be attached to each individual sample bottle. Sample tags are not required for Brownfield projects. The label will include the field sample number, date/time of collection, type of analysis, sampler initials, and project name. Labels will be annotated with waterproof, permanent ink. CRL sample numbers will be written or pre-printed on the sample labels. CRL sample numbers will be assigned as needed for this project, and will be obtained from the U.S. EPA (Jan Pels, at this time). Generally, the CRL sample numbers are in the form of a 9 digit number, such as 99BF04S01. The '99' indicates the U.S. EPA fiscal year in which the samples are collected (U.S. EPA fiscal years begin October 1 and end the following September 31). The code 'BF' has been assigned to the Brownfield program pilots. The remainder of the number is a sequential number assigned by U.S. EPA such that each sample number is unique. Field blanks and trip blanks will be identified by coding the samples with an 'R' in place of the 'S', e.g., the first field blank or trip blank will be 99BF04R01; the second will be 99BF04R02. Water field duplicate samples will be identified by the CRL sample number by substituting a 'D' in the same sample number, e.g., 99BF04S01 and 99BF04D01 would be field duplicates. If the CRL is to be scheduled to analyze samples, a block of CRL sample numbers will be assigned (i.e., 99BF04S01-S99). The first sample would be 99BF04S01, the next would be 99BF04S02, etc. The project consultant will keep track of which CRL log numbers assigned are used and will request more sample numbers if needed. Sample numbers not used will be returned to U.S. EPA for use with another project. Beginning on Oct. 1, 1999, the fiscal year 2000 begins, and sampling numbers will be assigned with the following format: 2000BF01S01.

Samples shipped to the CRL will be documented on a Chain of Custody (COC) form (see example). The COC form will be filled out as in the example, including the site name, sampler names/signatures, time/date of sampling (in military time), type of sample, CRL sample number, the field station location, analyses requested will be listed in the right hand columns, the numbers of the COC seal numbers on the cooler, airbill number. The completed COC form should be enclosed in a ziplock baggie taped to the inside lid of the cooler that contains the samples listed on the form. The CRL shipping Address is:

Bill Sargent,
U.S. EPA, Region 5
Central Regional Laboratory
536 S. Clark St.
10th Floor
Chicago, IL 60605
(312) 353-9083

Call Bill Sargent at the number above daily after shipment to the CRL, with airbill number, number of samples shipped, matrix, analyses requested, etc. Bill Sargent can be contacted concerning return shipment of empty coolers.

National Contract Laboratory Program (CLP):

Sample labels will be prepared in a similar manner for samples shipped to the (CLP), except the site name will NOT be written on the sample label. Sample tags are not required for Brownfield projects. In place of the site name, the U.S. EPA assigned Case number will be written on the label. In addition, U.S. EPA will supply sample number labels for the CLP samples. These sample number labels will be used for this project only for samples scheduled through the CLP, and will be specific numbers for Region 5 U.S. EPA. These are the sample numbers that the lab results will be reported with. Region 5 labels begin with the letter 'E' for the organics and with 'ME' for inorganics. The 'E' represents Region 5 (E is the 5th letter in the alphabet; Region 1 labels begin with the letter 'A', Region 2 labels begin with the letter 'B', etc.). Typically, the organic and inorganic samples will be shipped to different laboratories. Samples shipped to the CLP will be documented on the CLP COC/Traffic Report form. This form is a standardized form used by all who send samples to the National CLP. The reverse side of the form contains instructions on completing the form. This form should be filled out and shipped in a ziplock baggie taped to the inside lid of the cooler that contains the samples listed on the form. In addition, a third party air bill should be in the ziplock baggie, to be used by the CLP lab to return the coolers. A return address should be clearly identified on the airbill and on the cooler.

Call Charles Hutchinson, Dyncorp, at (703) 715-4814 daily with the airbill number, lab name(s), number and matrix of samples shipped, analyses requested, etc. Keep Howard Pham, Region 5 RSCC, (U.S. EPA (312) 353-2310) updated as the sampling event progresses, and let him know if the sampling is on schedule or if it'll run into the next week.

Sample Scheduling:

Once the sampling and analysis plan is approved for specific site work, a sampling projection form will be filled out by the project consultant. This form will reflect the work approved in the sampling plan by the U.S. EPA project manager, and will be submitted to the Regional Sample Control Coordinator (RSCC), Howard Pham, by the 15th of the month prior to the month of sampling or as soon as the sampling plan is approved. A copy should also be sent to the U.S. EPA Brownfield project manager. The week before sampling, the consultant must FAX the sampling confirmation form to the RSCC, and will cc: the U.S. EPA Brownfield project manager. The RSCC will forward the weekly projections to the U.S. EPA contractor, Dyncorp, to get a case number assigned for that week, and to get the organic and inorganic laboratory assignments. The case number and laboratory addresses will be FAXed to the project consultant by the Friday before the week of sampling. The samplers must call Dyncorp daily once sampling has begun, to report sample shipments to the CLP labs. Bill Sargent, U.S. EPA must be contacted daily if samples are being shipped to the CRL.

Appendix C

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION V

OFFICIAL SEAL

No 24001

Example; Custody Seal

Case # or Project Code	Sample Number	Month/Day/Year	Time	DESIGNATE																																							
				Comp.	Grab																																						
Tag Number 5-022000	Station Number and Location		Samplers (signatures)																																								
	USE FOR MS/MSD <input type="checkbox"/> Matrix: _____ Remarks: _____		PRESERVATIVE: H ₂ SO ₄ <input type="checkbox"/> IGE <input type="checkbox"/> HCL <input type="checkbox"/> HNO ₃ <input type="checkbox"/> NaOH <input type="checkbox"/> Other <input type="checkbox"/> ANALYSES <table border="1"> <tr> <td>VOA</td> <td>METALS</td> </tr> <tr> <td>ABN</td> <td>CYANIDE</td> </tr> <tr> <td>PEST/PCB</td> <td></td> </tr> <tr> <td></td> <td>Mercury</td> </tr> <tr> <td>Pesticides</td> <td>Fluoride</td> </tr> <tr> <td>Herbicides</td> <td>Nitrate/Nitrite</td> </tr> <tr> <td>PCB</td> <td>TOC</td> </tr> <tr> <td>PCDD/PCDF</td> <td>BOD</td> </tr> <tr> <td>2,3,7,8-TCDD</td> <td>COD</td> </tr> <tr> <td>Ames Mutagen</td> <td>TDS</td> </tr> <tr> <td>Asbestos</td> <td>TSS</td> </tr> <tr> <td>Phosphorus</td> <td>O&G</td> </tr> <tr> <td>Phenols</td> <td>Sulfate</td> </tr> <tr> <td>PAH</td> <td>Chloride</td> </tr> <tr> <td>TCLP</td> <td>Sulfide</td> </tr> <tr> <td>TOX</td> <td>Ammonia</td> </tr> <tr> <td>CBOD</td> <td>Alkalinity</td> </tr> <tr> <td>Bio-Acute</td> <td>Acidity</td> </tr> <tr> <td>Bio-Chronic</td> <td>TKN</td> </tr> </table>				VOA	METALS	ABN	CYANIDE	PEST/PCB			Mercury	Pesticides	Fluoride	Herbicides	Nitrate/Nitrite	PCB	TOC	PCDD/PCDF	BOD	2,3,7,8-TCDD	COD	Ames Mutagen	TDS	Asbestos	TSS	Phosphorus	O&G	Phenols	Sulfate	PAH	Chloride	TCLP	Sulfide	TOX	Ammonia	CBOD	Alkalinity	Bio-Acute	Acidity	Bio-Chronic
VOA	METALS																																										
ABN	CYANIDE																																										
PEST/PCB																																											
	Mercury																																										
Pesticides	Fluoride																																										
Herbicides	Nitrate/Nitrite																																										
PCB	TOC																																										
PCDD/PCDF	BOD																																										
2,3,7,8-TCDD	COD																																										
Ames Mutagen	TDS																																										
Asbestos	TSS																																										
Phosphorus	O&G																																										
Phenols	Sulfate																																										
PAH	Chloride																																										
TCLP	Sulfide																																										
TOX	Ammonia																																										
CBOD	Alkalinity																																										
Bio-Acute	Acidity																																										
Bio-Chronic	TKN																																										
Lab Sample Number																																											

Example; Sample Tag

CHAIN OF CUSTODY RECORD

[illegible]

APPENDIX D

Completed Special Analytical Services Request Form

5/026-6/96

U.S. Environmental Protection Agency Region V
SFD/Contracts Mgmt. Section
77 West Jackson, SM-5J
Chicago, Illinois 60604
PHONE: (312) 886-1488 FAX: (312) 886-0753

SAS Number

SPECIAL ANALYTICAL SERVICES
Client Request

☐ Regional Transmittal

A. EPA Region/Client: Region V
B. RSCC Representative: C. Luckett Technical Project Officer (TPO): B.P. Freeman
C. Telephone Number: (312) 886-1488 (312) 353-2720
D. Date of Request:
E. Site Name:
Cerclis ID# Site/Spill ID#

Please provide below a description of your request for Special Analytical Services under the Contract Laboratory Program. In order to most efficiently obtain laboratory capability for your request, please address the following considerations, if applicable. Incomplete or erroneous information may result in delays in the processing of your request. Please continue response on additional sheets, or attach supplementary information as needed.

1. General description of analytical service requested:

Determination of percent volatile solids in soil, wastes or other solid materials (including oil contaminated matter). Both % total solids (residue at 103-105°C) and percent volatile solids (residue at 550°C) will be determined and reported. Percent volatile solids are determined and reported on a dry weight basis (103-105°C). Results are reported as % solids. No deviation is allowed for any portion of this SAS without the permission of the TPO.

2. Definition and number of work units involved (specify whether whole samples or fractions; whether aqueous or soil and sediments; and whether low, medium, or high concentration):

3. Purposes of analysis (specify whether Superfund [Remedial or Enforcement], RCRA, NPDES, etc.):

4. Estimated date(s) of collection:

5. Estimated date(s) and method of shipment:

6. Number of days analysis and data required after laboratory receipt of samples:

7. Analytical protocol required (attach copy if other than a protocol currently used in this program):

1. EPA Method 160.3/160.4 1987 ed. (or most recent), Gravimetric, dried at 103-105° C or
2. Method 209F, "Standard Methods", 16th ed. Please Note Method 209F-4. The residue from the % total solids test is used to determine % volatile solids. Samples will be stored at 4°C until analysis and validation of results.

8. Special technical instruction (if outside protocol requirements, specify compound names, CAS

numbers, detection limits, etc.):

1. Representative sample aliquots will be obtained from the sample container. Remove any non-soil components (such as sticks or debris).
2. 5 to 10g sample aliquots are sufficient.
3. Sample and tare weights need only be accurately weighed to the nearest 10 mg.
4. Ignition of solids at 550°C shall be done for at least one hour.
5. Percent total solids aliquots are to be dried (at 103-105°C) to constant weight or dried overnight (at least 12 hours) at 103-105°C.

9. Analytical results required (if known, specify format for data sheets, QA/QC reports, Chain of Custody documentation, etc.). If not completed, format of results will be left to program discretion.

All procedures used must be clearly identified. All original raw data, forms, calculation worksheets, instrument read-outs, preparation forms, internal sample and/or extract chain of custody forms, strip charts and copies of pages from preparation, weighing, and analysis logbooks shall be submitted. All crossouts and/or notations made on the raw data shall be initialed and dated. If originals were submitted in another data package, photocopies may be submitted with a record of the location of the originals.

Bench records of tare weights, intermediate and final weights, duplicate samples and reference samples shall be provided. Dates and times of the determination of constant residue weights shall be included.

All records of analysis and calculations shall be legible, complete and sufficient to recalculate all sample concentrations and QC audit results.

10. Other (use additional sheets or attach supplementary information, as needed):

All original sample tags, chain of custody forms, SAS packing lists, airbills, and original data shall be submitted to the Region within the time frame listed in section 6 above. Photocopies may be submitted with a record of the location of the originals.

Payment of laboratories for this SAS analysis may be reduced if all procedures noted above are not followed and all required deliverables noted above are not supplied. The Region or its contractors shall not be charged further for the provision of required deliverables within this agreement.

11. Name of sampling/shipping contact: _____
Phone: _____

5/026-6/96

I. DATA REQUIREMENTS

<u>Parameter</u>	<u>Detection Limit</u>	<u>Precision Desired</u>
% Total Solids	Not Applicable	RPD of sample duplicates for % total solids and % volatile solids should be less than or equal to 10%.
% Volatile Solids	Not Applicable	

II. QC REQUIREMENTS

<u>Audits Required</u>	<u>Frequency of Audit</u>	<u>Limits</u>
Lab Blank (Empty Dish) *	At least one per group of 10 or fewer samples	± 20 mg
Lab Duplicate *	At least one per group of 10 or fewer samples.	RPD \leq 10%

*Please see Attachment I.

III. ACTION REQUIRED IF LIMITS ARE EXCEEDED:

Contact the Region.

Please return this request to the Region as soon as possible to expedite processing of your request for special analytical services. Should you have any questions or need any assistance, please call the Region.

ATTACHMENT I

DEFINITION OF QC AUDIT TERMS

- | | | |
|----|------------------------------------|--|
| 1. | Matrix Spike: | The sample is spiked before pretreatment (ie. digestion, distillation etc.) and subsequent analysis. |
| 2. | Lab Spike: | The sample is spiked after pretreatment at the time of analysis. If pretreatment is not necessary the sample is simply spiked and analyzed. |
| 3. | Matrix Duplicate: | The sample is split into duplicate aliquots and pretreated (ie. digestion, distillation etc.) for subsequent analysis. |
| 4. | Lab Duplicate: | The sample is analyzed in duplicate after pretreatment at the time of analysis. If pretreatment is not necessary the sample is simply analyzed in duplicate. |
| 5. | Preparation Blank: | Laboratory reagent water pretreated as a sample. |
| 6. | Lab Blank: | Laboratory reagent water (without pretreatment) analyzed as a sample. |
| 7. | Calibration Blank: | Analysis of calibration zero standard to verify baseline. |
| 8. | Calibration Verification: | A control standard prepared at a known concentration on the calibration curve (generally, a mid-range concentration). |
| 9. | Laboratory Control Standard (LCS): | A control standard, with a certified concentration, treated as a sample (including pretreatment, if necessary). |